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Spearfish Sewerage Needs, Lawrence County near Spearfish, South Dakota. Draft Environmental Impact Statement

Engineering-Science, Inc.
Denver, CO

Prepared for

Environmental Protection Agency
Denver, CO

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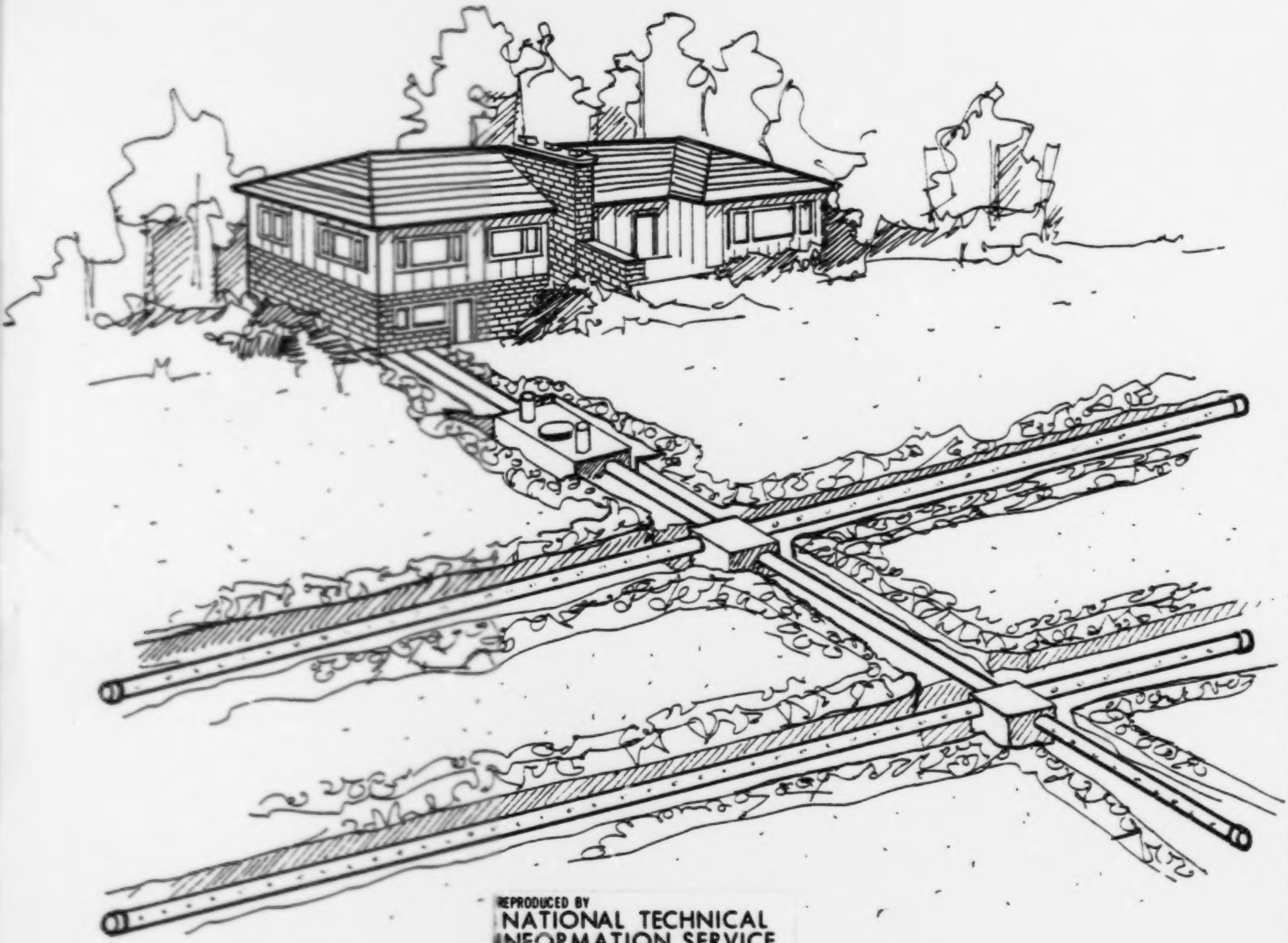
Draft

PB81-147092

Spearfish Sewerage Needs

Lawrence County near Spearfish, S.D.



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16. ABSTRACT

Surface and groundwater pollution problems have been identified in Spearfish Creek, Higgins Gulch, Christensen Drive, and the Belle Fourche infiltration gallery. Surface water quality problems have been demonstrated to be associated with nonpoint source pollution; while groundwater pollution in Christensen Drive and at the Belle Fourche infiltration gallery have been influenced by septic tank systems located in the alluvial bottoms of streams and by nonpoint sources.

In order to correct the water quality problems of the area it is recommended that nonpoint source control strategies be implemented and two new interceptor sewers be constructed. Based on local and state requirements, these interceptor sewer lines can only be funded if these unincorporated areas are incorporated into the City of Spearfish or into the Spearfish Valley Sanitation District. The estimated capital cost of the interceptors is $175,155.

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a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
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DRAFT ENVIRONMENTAL IMPACT STATEMENT
SPEARFISH SEWERAGE NEEDS
Lawrence County near Spearfish, S.D.

Prepared by

U.S. Environmental Protection Agency
Region VIII
1860 Lincoln Street
Denver, Colorado 80295

Approved by
Roger L. Williams
Regional Administrator

Date: OCT 10 1980

ACKNOWLEDGEMENTS

Because of the magnitude of the effort required to produce this environmental impact statement, it is an impossible task to acknowledge all of the people and agencies who contributed to the final product. A heart-felt thanks is extended to the individuals who have contributed and assisted in the completion of this monumental effort. A special thanks is offered to all of the secretaries without whose patience and long hours the project could not have been competed.

DISCLAIMER

This report has been reviewed by the EPA, Region VIII, Water Division and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

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SUMMARY SHEET

DRAFT ENVIRONMENTAL IMPACT STATEMENT

SPEARFISH SEWERAGE NEEDS
LAWRENCE COUNTY NEAR SPEARFISH, SOUTH DAKOTA

Prepared by the U.S. Environmental Protection Agency, Rocky Mountain Prairie Region, Region VIII, Denver, Colorado, with assistance from Engineering-Science, Inc., Denver, Colorado

A. Type of Action: (X) Draft EIS
( ) Final EIS

B. Brief Description of the Proposal

The Region VIII Administrator of the U.S. Environmental Protection Agency (EPA) intends to approve Federal matching funds for construction grant eligible wastewater treatment facilities for unincorporated areas around Spearfish, South Dakota. The funds will be provided through Title II of the Federal Water Pollution Control Act Amendments of 1972 (PL 92-500), as amended in the Clean Water Act of 1977 (PL 95-217). Eligibility requirements and procedures necessary to qualify for a grant are set forth in 40 CFR, Part 35, Construction Grants for Wastewater Treatment Works. The Federal share shall be 75 percent of the total cost found to be eligible.

The purpose of this environmental impact statement is to present an evaluation of the environmental consequences associated with various alternatives for wastewater management in areas outlying the City of Spearfish. The primary issues include: the feasibility of continued use of on-site wastewater disposal methods, nonpoint source controls, floodplains, and development.

In July 1978, a Wastewater Facilities Plan for Spearfish, South Dakota was submitted to EPA and the South Dakota Department of Environmental Protection for approval. The plan requested Federal funding assistance for the construction of over 10 miles of interceptors to collect and convey wastewater from the outlying areas of Spearfish. The plan left unanswered critical questions concerning the effects the interceptors would have on development in the area. EPA decided to prepare this environmental impact statement in order to re-evaluate the original facilities plan alternatives and concurrently has requested the City of Spearfish to update the facilities plan to include amended alternatives analysis presented in this impact statement.

C. Lead Agency, Project Officer Contact and Address

The U.S Environmental Protection Agency is the lead agency in a joint effort with the State of South Dakota and the City of Spearfish, South Dakota, to approve plans, necessary permits, and finance or award grants in order to implement this proposal. Mr. Weston Wilson, U.S. Environmental Protection Agency, Region VIII is the designated project officer.

Requests for free copies of this document should be addressed to:

Mr. Weston W. Wilson, Project Officer
U.S. Environmental Protection Agency
Region VIII
1860 Lincoln Street
Denver, Colorado 80295

or call (303) 837-4831.

D. Abstract of the Proposed Action

Surface and groundwater pollution problems have been identified in Spearfish Creek, Higgins Gulch, Christensen Drive, and the Belle Fourche infiltration gallery. Surface water quality problems have been demonstrated to be associated with nonpoint source pollution; while groundwater pollution in Christensen Drive and at the Belle Fourche infiltration gallery have been influenced by septic tank systems located in the alluvial bottoms of streams and by nonpoint sources.

In order to correct the water quality problems of the area it is recommended that nonpoint source control strategies be implemented and two new interceptor sewers be constructed: 1) a 3800 foot, 8 inch gravity sewer line up Christensen Drive, and 2) a 4000 foot, 8 inch sewer line with a 2050 foot force main to the West Subdivision in the lower Spearfish Valley. Based on local and state requirements, these interceptor sewer lines can only be funded if these unincorporated areas are incorporated into the City of Spearfish or into the Spearfish Valley Sanitation District. The estimated capital cost of the Christensen Drive interceptor is $57,220 and the West interceptor is $117,935.

Public health hazards were also identified with two failing septic tank systems and 12 suspected seasonal failures. The two failing systems are to be corrected under the direction of the Northern Hills Sanitarian and the suspected seasonal failures will be monitored. Should failures occur, corrective action is to be taken.

E. Date filed with EPA and listed in the Federal Register:

OCT 10 1980

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Queen City Mail
Scott Engineering
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Woodward Clyde Consultants
Culp/Wessner/Culp, Inc.

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SUMMARY AND PROPOSED EPA DECISION

CHAPTER 1

CHAPTER 1

SUMMARY AND PROPOSED EPA DECISION

This Environmental Impact Statement (EIS) evaluates the environmental consequences of alternative methods of wastewater disposal in the outlying areas of Spearfish, South Dakota. The need for wastewater treatment for the City of Spearfish is evaluated in a separate document. The environmental assessment, which evaluates treatment alternatives for Spearfish, was released April 17, 1980. This EIS is prepared in response to documented groundwater and surface water pollution problems in the outlying areas of Spearfish (see Figure 1-1). Surface and groundwater pollution was suspected to be originating from septic tank systems. Wastewater was considered to be:

- The source of sporadic groundwater contamination at and around the Belle Fourche infiltration gallery.
- The cause of surface water contamination in Higgins Gulch and Spearfish Creek.
- The cause of groundwater contamination in the Higgins Gulch area, Mountain Plains area and Christensen Drive area.

A Wastewater Facilities Plan, prepared in 1978, recommended that nearly ten miles of interceptors be built to sewer outlying areas to solve these problems because septic tanks were believed unsuitable as a means of sewage disposal. However, EPA was not sure this was the best approach given the undesirable growth related environmental effects which may result. Consequently, an amended Facility Plan was prepared, supported by special environmental studies conducted for this EIS, which examine methods of solving water quality and wastewater treatment problems in greater detail.

WATER POLLUTION PROBLEMS

In order to identify the specific needs a comprehensive understanding of the extent and causes of the water pollution problems is necessary. This first step is essential because the specific source of the pollution is not known. To facilitate this analysis the study area is segregated by developing areas in the outlying areas of Spearfish (see Figure 1-2).

The City of Belle Fourche has stated that the contamination of their infiltration gallery has been caused by septic tank effluent entering surface and groundwater where concentrated development has occurred

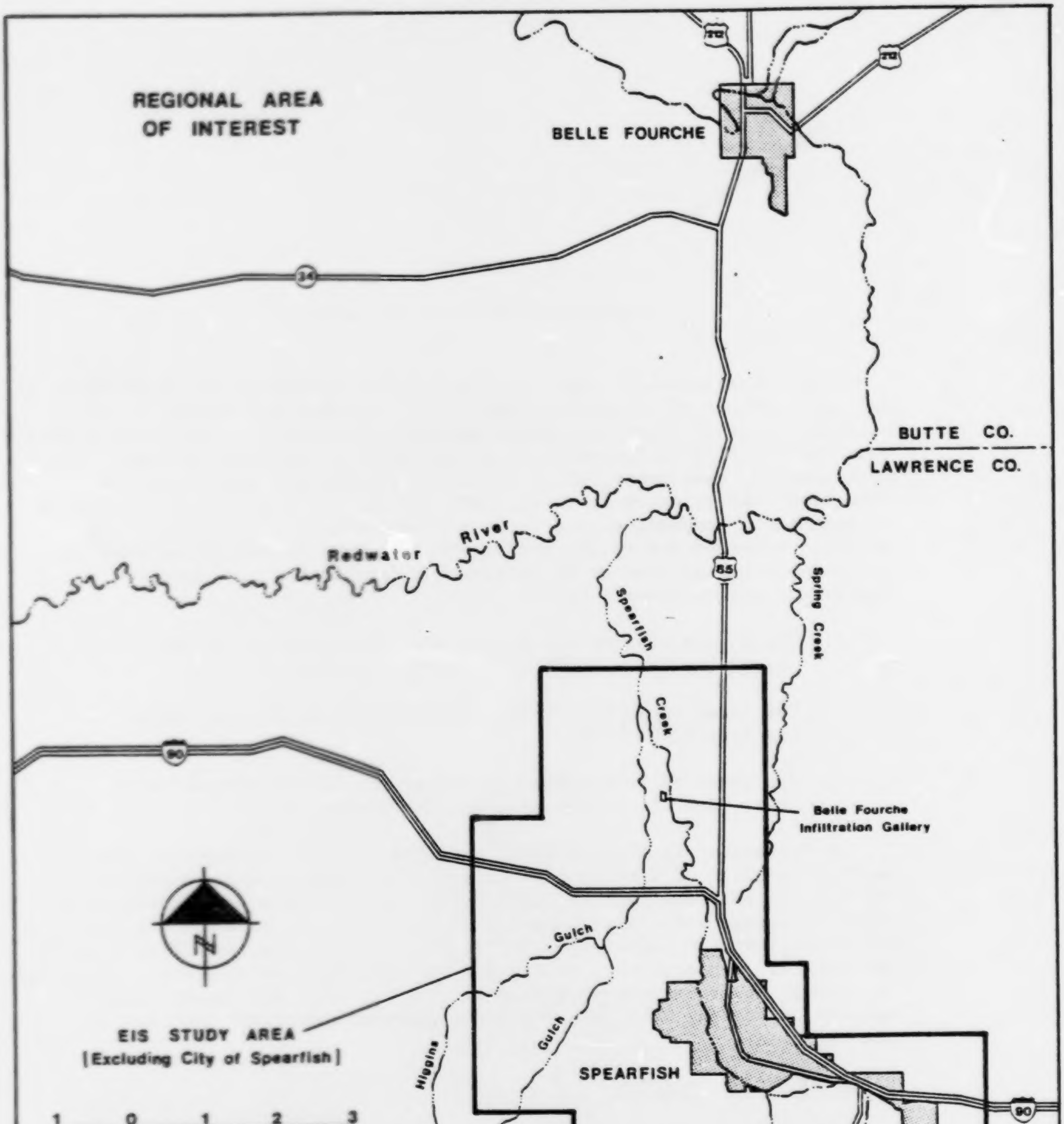
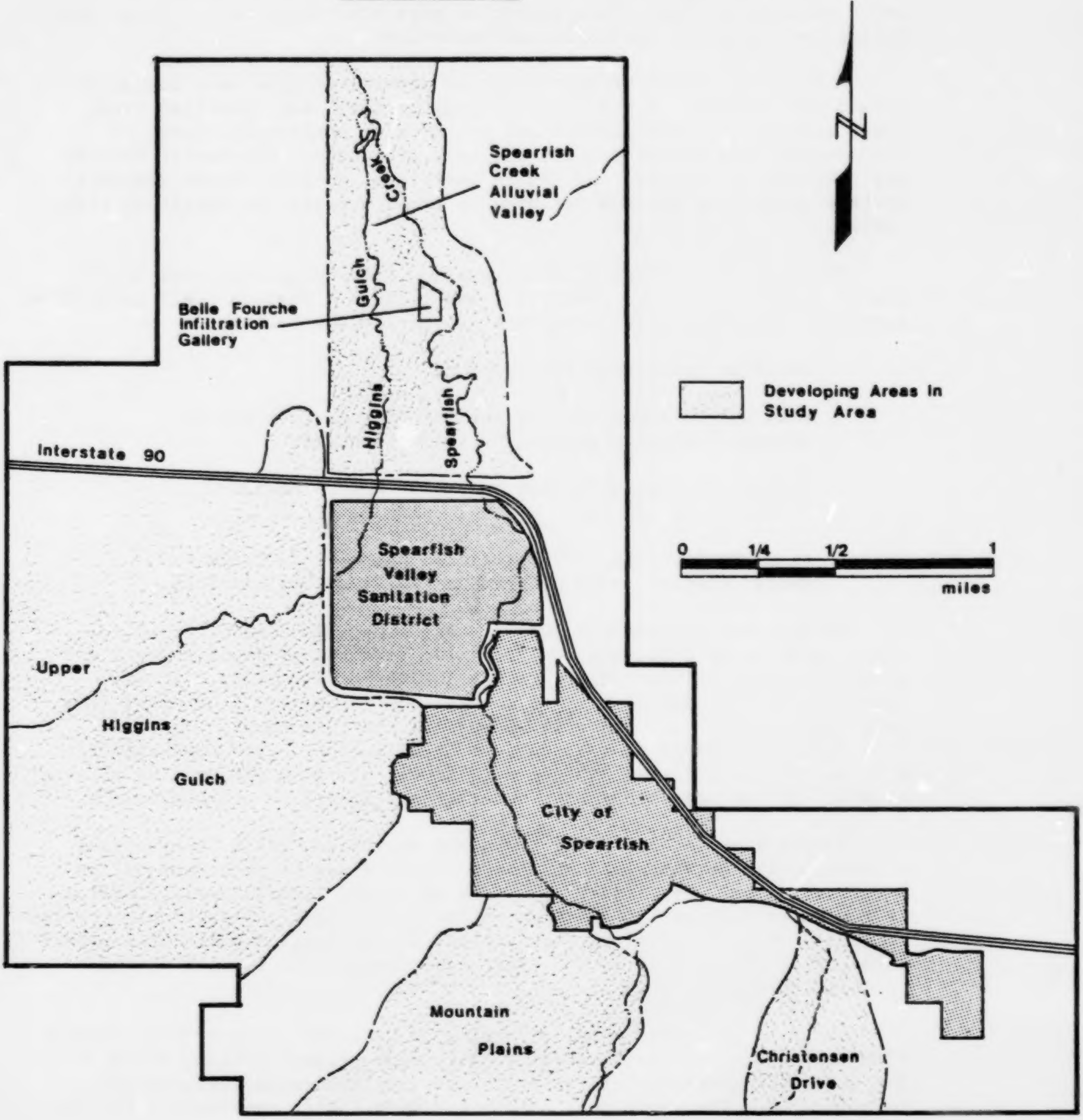

REGIONAL AREA OF INTEREST
BELLE FOURCHE
212
212
34
BUTTE CO.
LAWRENCE CO.
Redwater River
85
Spearfish Creek
Spring Creek
90
Belle Fourche Infiltration Gallery
N
Gulch
Higgins
Gulch
Johnston
EIS STUDY AREA [Excluding City of Spearfish]
SPEARFISH
90
1 0 1 2 3
miles

FIGURE 1-1

FIGURE 1-2

EIS STUDY AREA


Spearfish Creek Alluvial Valley
Creek
Gulch
Higgins
Spearfish
Belle Fourche Infiltration Gallery
N
Developing Areas in Study Area
Interstate 90
Spearfish Valley Sanitation District
0
1/4
1/2
1
miles
Upper
Higgins
Gulch
City of Spearfish
Mountain
Plains
Christensen
Drive

(specifically, adjacent to Higgins Gulch). Water sampling at the infiltration gallery indicated relatively good quality until the summer of 1977. In 1977 samples began to show high levels of coliform bacteria, an indicator of disease risk. This condition persisted until 1979. Water samples during 1979 have not indicated contamination.

During the period of contamination several studies were conducted around the gallery, in the areas of Higgins Gulch, and Spearfish Creek. These studies included surface and groundwater monitoring, depth to groundwater, and aerial imagery and interpretation. The aerial imagery was utilized to identify and locate individual on-site sewage disposal systems exhibiting surface failures in areas outside the Spearfish city limits.

Through aerial imagery interpretation fifty-nine suspected septic system malfunctions were identified and located. Through field inspection, suspected failing septic tanks were categorized as follows:

- verified failures - two systems,
- seasonal failures, during periods of heavy use and/or moderate to heavy rainfall - twelve systems,
- changes in vegetation but no public health hazard - thirty-three systems
- false indications, not associated with septic tanks - twelve systems (such as artesian wells or roof drains).

Surface and groundwater quality data were evaluated to identify types, sources of pollution and hydraulic features of Higgins Gulch and Spearfish Creek as they relate to the infiltration gallery. It was demonstrated that groundwater at the gallery is recharged by water from both Higgins Gulch and Spearfish Creek and that groundwater movement from Higgins Gulch is in a northeasterly direction. This condition is a result of the groundwater,from Higgins Gulch moving through the alluvial material in its stream bed then entering the Spearfish Creek alluvium.

Sewage disposal by septic tanks and absorption field is practiced at residential developments which are within a few hundred feet of the infiltration gallery. Spearfish Creek is in the same alluvial deposits as the Belle Fourche infiltration gallery. The next closest concentration of developments using septic systems are in the Higgins Gulch area, about three miles from the gallery. These developments are located on the Spearfish Creek bench areas.

Soils in the bench area, according to U.S. Soil Conservation Service (SCS) are clay-loam and because of their slow permeabilities, not suited for septic tank absorption fields unless special design features are incorporated. The tight soil conditions were likely responsible for the high number of indications of surface failure identified in the aerial imagery. It has been found that septic tank leach fields located near the surface function as evapotranspiration systems. This coupled with undersized leach fields result in the effluent being taken up by the cover vegetation and creating a lusher, healthier vegetation than the surrounding area. Under these circumstances effluent does not appear to move downward toward the groundwater table.

Because most of the developed area in Higgins Gulch is on these clay-loam soils, it is concluded that septic tank leach field effluent is not causing bacterial contamination of the groundwater. Furthermore, septic systems which are deeper are not suspected of bacterial pollution of the groundwater because it has been demonstrated that coliform bacteria are usually filtered by the soil after approximately four feet of **vertical percolation.**

With respect to fecal coliform contamination near the Belle Fourche infiltration gallery, there is no consistent pattern of surface or groundwater contamination. It has been demonstrated that there is some correlation between rainfall events and groundwater pollution. The analysis indicates that coliform contamination of the surface waters of Higgins Gulch and Spearfish Creek below Spearfish is likely caused primarily by nonpoint discharge sources. Nonpoint discharges are also contributing to groundwater contamination in the Spearfish Creek-Higgins Gulch alluvium in the vicinity of the Belle Fourche infiltration gallery where naturally high groundwater conditions exist. Furthermore, high surface water flows during storm events increase groundwater elevations in and around the alluvium of the gallery which cause short-circuiting of septic tank absorption fields associated with West development on the alluvium, thus aggrevating coliform contamination of the groundwater.

Additional data have recently (1979) been collected on groundwater levels in the Spearfish Valley north and west of Spearfish (1). These data indicate that houses in the upper Higgins Gulch area are not in violation of septic tank codes relative to groundwater because the groundwater level is over fifteen feet deep. However, the water table is quite shallow in the alluvial area around the infiltration gallery and septic systems in this area could contribute to contamination of the gallery. Another source of contamination is manure from a livestock confinement area at the mouth of Higgins Gulch which may be contacting Higgins Gulch water where it sinks into the alluvium. It should be noted that in 1979 the spring and early summer precipitation was below average. Under average conditions, the seasonal high water table may be higher than the 1979 data indicate.

One large septic system serving a campground (Chris' Campground) located along Christensen Drive was found, **using aerial imagery, to fail on** a seasonal basis. During summer months, wastewater loads are excessive, causing an overloading of the leach field. It appears that the septic tank/leach field is **underdesigned for the number of people using the** system.

An intermittent stream drains the area of Christensen Drive southeast of the City of Spearfish. Test results indicate abnormal fecal coliform counts in the stream at a spring. Additional samples taken from a well at the Miller Ranch (located at the mouth of Christensen Drive) confirmed groundwater contamination in the drainage area.

AMENDED FACILITY PLAN

The purpose of the Amended Facility Plan is to develop correctional measures for identified pollution problems within the Study Area. Correction measures are necessary to assure adequate control of surface and groundwater pollution, and protection of public water supplies.

The alternatives evaluated include:

- No Federal Action - upgrade verified failing septic tank systems by individual owners.
- Holding tanks.
- Evapotranspiration systems.
- Sewer interceptors connected to the proposed upgraded Spearfish wastewater treatment plant.

CONCLUSIONS

Evaluation of data relative to groundwater depth and movement, ground and surface water quality, rainfall events, soils, geology, and contamination of the Belle Fourche water supply resulted in EPA concluding:

- Surface water pollution in Higgins Gulch and Spearfish Creek is a consequence of nonpoint source pollution originating from livestock confinement and pasturing areas, urban areas, and undeveloped areas.
- Sporadic groundwater contamination of the Belle Fourche infiltration gallery is the result of nonpoint sources entering Higgins Gulch and Spearfish Creek and septic tank systems in the area of the West development in the Spearfish Creek Alluvial Valley.
- Septic tank systems in the Upper Higgins Gulch area, on the Spearfish Creek bench are not contributing to the sporadic contamination of the Belle Fourche infiltration gallery.
- Surface and groundwater in Christensen Drive has been contaminated by septic tank systems in the alluvial valley, and Chris' Campground.
- Septic tank systems are an acceptable means of wastewater treatment and disposal in the Upper Higgins Gulch area but are not acceptable in the Spearfish Creek Alluvial Valley particularly near the Belle Fourche infiltration gallery. Furthermore, septic tank systems are not desirable for wastewater treatment where site specific conditions do not conform to South Dakota regulations. When site specific conditions are not adequate for conventional septic tank systems

(Mountain Plains) specially designed systems which overcome problems may be acceptable.

- Water quality and wastewater treatment was not demonstrated to be a problem in the Mountain Plains area at this time. However, future problems could develop if wastewater management is not closely monitored as development occurs.

- A survey of the 12 suspected seasonal failing septic tanks indicates that leach fields are not adequately designed according to South Dakota regulations. Two confirmed septic tank failures have been identified.

EPA DECISION

EPA purposes the following decision:

a) To approve for grant eligibility under the Clean Water Act 75 percent funding for two new sewer interceptors: 1) a 3800 foot 8 inch gravity sewer line up Christensen Drive and 2) a 4000 foot 8 inch sewer line and a 2050 foot force main and pump station to the West Subdivision in lower Spearfish Valley. Such new sewer interceptors can only be funded if these unincorporated areas are incorporated into the City of Spearfish (Christensen Drive) or into the Spearfish Valley Sanitation District (West Subdivision). The estimated capital cost of the Christensen Drive interceptor is $57,220 and of the West interceptor is $117,935 (See Appendix D and the Amended Facility Plan for a complete cost analysis of these proposed interceptors and other alternatives).

b) EPA requests that the South Dakota Department of Natural Resources (DNR), when possible, work closely with the local and county zoning and health officials in insuring enforcement of the state approved septic tank codes with respect to new and existing residential construction near the City of Spearfish. The Black Hills Sanitarian has ordered conversion of two residences identified as having definite surface failures. EPA requests that the State Department of Natural Resources and the Black Hills Sanitarian continue to monitor the 12 residences identified as having suspected seasonal failures.

Should surface failures occur that in the opinion of DNR represent public health nuisances they should advise the Black Hills Sanitarian to take corrective actions. As most homes are on half-acre lots, over 20,000 square feet, it is EPA's opinion that there is sufficient space for leach field expansion in order to comply with the state codes. This corrective action should be done at the owner's expense.

c) EPA proposes to restrict grants to the City of Spearfish and/or the Spearfish Valley Sanitation District such that no new sewer connections will be allowed within the designed 100 year floodplain area of these two jurisdictions as of the date of the grant award.

The proposed grant condition is: "The grantee and local jurisdictions in the Spearfish Service Area shall not accept a sewerage connection to any interceptor funded by this grant, from any residential, commercial or industrial structure receiving a local building permit after the date of this grant, if the structure is located within a designated 100-year floodplain. The grantee and local jurisdictions are permitted to accept a sewerage connection from any residential, commercial or industrial structure located within a designated 100-year floodplain, if the structure is in existence or was issued a local building permit prior to the date of award of the Step 2 grant."

A variance of this condition will be considered by EPA if the grantee, in conjunction with each local jurisdiction in the Spearfish Service Area submits site-specific documentation (including detailed maps of specific plats recommended for variances) that there is no practicable alternative to development within the 100-year floodplain. A minimum requirement for a variance to be granted is a demonstration that the procedures outlined in Floodplain Management Guidelines dated February 10, 1978 have been followed. If such a variance is granted, the proposed structures must comply with the floodplain management standards of the National Flood Insurance Program, and the proposed floodplain development will not alter the 100-year floodplain so as to increase the risk of flooding to upstream or downstream property. Under no circumstances, will a variance be granted for development located in the floodway as defined by the National Flood Insurance Program and identified on HUD Flood Boundary Maps. The grantee should refer to Federal Executive Order 11988 dated May 24, 1977, pertaining to Floodplain Management and EPA's Statement of Procedure for Floodplain Management and Wetlands Protection, dated January 5, 1979 (44 CFR 1455)".

d) Spearfish and Lawrence County shall also pursue nonpoint source control measures as identified in the Black Hills 208 plan and this EIS, whereby an adopted and approved erosion and sediment control ordinance is enacted.

e) Because many of these problems have resulted from improper or unrestricted development in the Study Area, EPA advises Lawrence County to:

1) Enforce strict adherence to South Dakota codes on individual disposal systems especially determination of the seasonal high groundwater level. EPA recommends that Lawrence County Board of Supervisors continue to approve properly designed septic systems in the Higgins Gulch and bench area, but that they should develop a policy of excluding septic tank installation from areas within the Spearfish Valley alluvium that have groundwater within ten (10) feet of the surface.

2) Implement a floodplain regulation similar to the one EPA proposed for the City of Spearfish and the Spearfish Valley Sanitation District whereby all residential development is prevented in the designated 100-year floodplain unless no practical alternative exists.

3) Pursue and develop community acceptable nonpoint source controls as identified in the Black Hills 208 plan and this EIS whereby sources of stream pollution such as improper irrigation practices, excessive concentration of cattle and solid waste dumping in streams is controlled by the county.

PURPOSE AND NEED

CHAPTER 2

CHAPTER 2

PURPOSE AND NEED

The existing wastewater treatment facility of the City and the Sanitation District is a two-stage stabilization pond (lagoon) that was constructed in 1972. Shortly after the discharge of wastewater into the ponds, excessive exfiltration occurred and untreated wastewater began flowing into the Spring Creek drainage (See Figure 1-1). The remaining areas of the study area use on-site wastewater facilities.

On August 10, 1978, a 201 Wastewater Facilities Plan for Spearfish, South Dakota was submitted to the South Dakota Department of Environmental Protection (DEP) and the U.S. Environmental Protection Agency (EPA) for approval (2). The facilities plan addressed the wastewater treatment and management needs of the designated 201 study area. In addition to the City of Spearfish, the study area includes the Spearfish Valley Sanitation District and four development areas.

- Christensen Drive
- Mountain Plains
- Higgins Gulch
- Weiss-West Developments

These features, as well as other cultural features of the area, are illustrated on Figure 1-2.

The facilities plan recommended the construction of a new wastewater treatment plant with a capacity of 0.8 million gallons per day (MGD) to serve the 1990 estimated population of 10,300 people. The plan also recommends construction of approximately 10 miles of interceptor sewers into presently unsewered areas to eliminate suspected groundwater contamination.

The recommendation of the facility plan for extensive sewer interceptors and a new wastewater treatment facility were developed based on the following conclusions:

- Excessive exfiltration from the stabilization ponds is contaminating the groundwater and surface water of the Spring Creek drainage and is a severe threat to health.
- The geologic strata within the study area poses a risk of potential groundwater contamination by wastewaters treated or stored in stabilization or holding ponds.

- Septic tank - leach field individual treatment systems are contaminating the groundwaters and potable drinking waters in the Spearfish Creek and Higgins Gulch alluvial drainages.

- Development within the study area is haphazard with no planning as to location of development in relation to floodplain or with regards to proper wastewater treatment and disposal.

- Infiltration into portions of the sewer collection system is excessive and requires additional investigation.

- A wastewater treatment facility that produces a high quality effluent must be provided to meet the stream water quality standards of Spearfish Creek and to maintain the aesthetic and environmental quality of the Study Area.

Because of the severe pollution and public health hazards associated with the failing sewage lagoons, work is proceeding with the development of alternatives for a new plant. This new plant will be sized for an initial staging period of ten years. A staged approach is selected so that the immediate needs for wastewater treatment can be met while additional evaluation is conducted of sewerage needs in unsewered areas. (See EPA's Final Environmental Assessment dated April 17, 1980, for a description of the problems of wastewater treatment and site selection for the City of Spearfish.) The South Dakota Department of Natural Resources and EPA have prepared a revised environmental assessment which recommends approval of an oxidation ditch system with filters near the existing lagoons followed by a discharge to lower Spring Creek.

EPA determined that adverse environmental impacts, including induced development in floodplains may result from construction of the recommended interceptors into outlying areas. The City of Spearfish was required to re-evaluate alternatives for wastewater management in the outlying areas to determine the most environmentally sound and cost-effective management strategy. This action is predicted on the fact that surface and groundwater in the Study Area has experienced pollution above acceptable limits and that contamination of the Belle Fourche water supply has resulted as a consequence of this pollution.

ALTERNATIVES

CHAPTER 3

CHAPTER 3

ALTERNATIVES

INTRODUCTION

The City of Spearfish has proceeded with the development of alternativesfor wastewater treatment to correct problems associated with their failing lagoons. The City has also retained the engineering firm of Scott Engineering to reevaluate wastewater management alternatives for the unsewered area outside the City limits and the Spearfish Valley Sanitation District. This environmental impact statement is being prepared in conjunction with the update of the 201 Facility Plan for these outlying areas.

In recent years there has been an increase in septic tank-leach field systems in outlying areas as a consequence of increased residential development. Concern has been expressed that these on-site systems are potentially contaminating groundwater and the Belle Fourche water supply.

ORIGINAL ALTERNATIVES

The original Facilities Plan, prepared by Brady Engineers in 1978, recommends that developments in outlying areas abandon their on-site systems and connect to the City's sanitary sewerage system. This selected action was predicated on the suspicion that these systems were potentially contaminating groundwater in the area.

Several wastewater treatment alternative systems were considered in the original Facilities Plan as feasible for development in the outlying areas. These alternatives include:

- interceptor sewers connected to the City system
- holding tanks
- evapotranspiration systems

Operation and maintenance of the interceptor sewers would be the responsibility of the City. Holding tanks require pumping on a regular schedule with primary responsibility with the homeowner. The evapotranspiration system would require pumping during the winter when the rate of evapotranspiration is reduced, to prevent system overflow. The homeowner would have the primary responsibility for maintenance of the evaportranspiration system. Pumpage from the holding tanks and evapotranspiration systems would be treated in the City treatment plant.

Each of these alternative treatment systems is evaluated in terms of their applicability to the unsewered outlying developments. These developments are separated into the following areas:

- Spearfish Creek Alluvial Valley
- Upper Higgins Gulch
- Mountain Plains
- Christensen Drive

These developments are illustrated on Figure 3-1.

Spearfish Creek Alluvial Valley

Two developments are located in the Spearfish Creek Alluvial Valley, the Hope Weiss Development (Brookview Acres) and the West Subdivision (Hubbard Development), along with scattered residential and agricultural developments, (See Figure 3-2).

The Hope Weiss Development, except for one dwelling, is connected to the City of Spearfish's sewer system via a privately owned transmission line. This line is preceded by a small package-type wastewater treatment plant. The remaining developments in the area are on individual disposal systems.

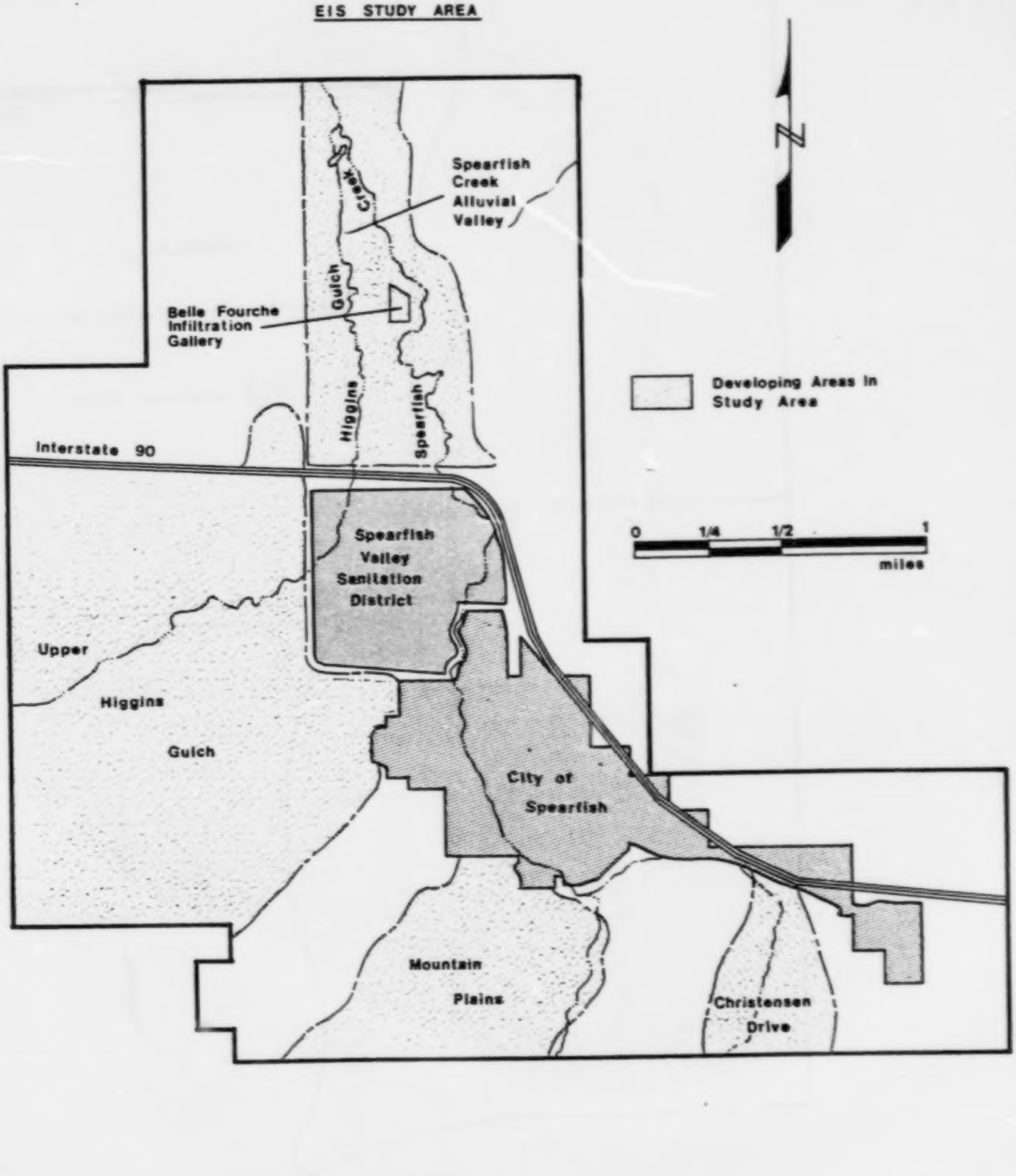
The original Facility Plan states that the City must allow the West Subdivision to connect to the existing interceptor sewer. This is to eliminate the threat to local groundwaters and the Belle Fourche water supply of being contaminated.

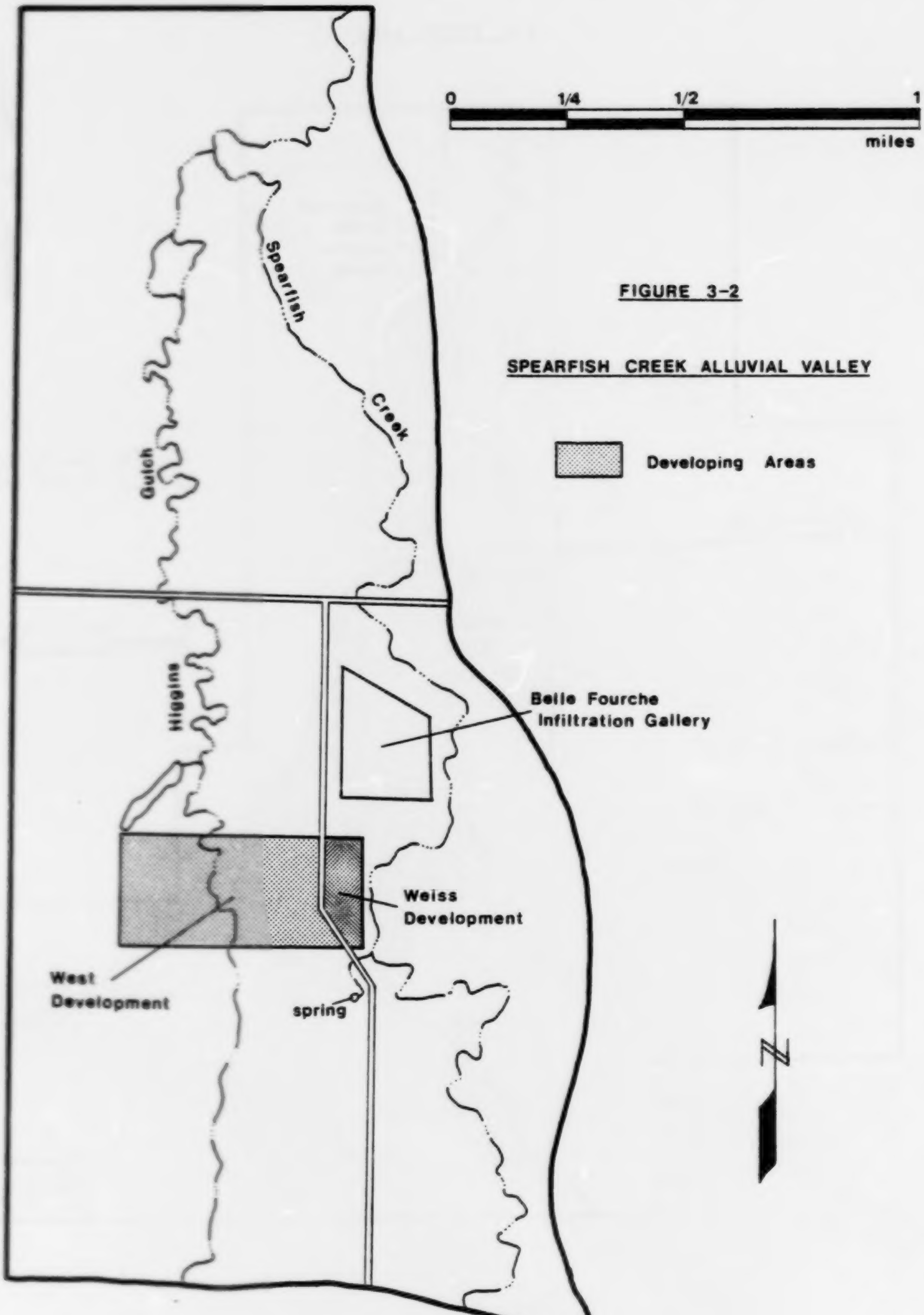
The original Facility Plan identified six trailer homes with a potential occupancy of 35 homes on the existing lots. Twenty-year population projection for the development is 105. Design peak flow would be 16,000 gallons per day (gpd).

Original cost estimates were developed for the three wastewater treatment alternatives. The interceptor sewer alternative would consist of an eight-inch interceptor with a lift station and a four-inch pressure line to the existing 18-inch interceptor from the City of Spearfish. A summary of the original cost estimates of the alternatives is presented in Table 3-1.

FIGURE 3-1

EIS STUDY AREA


Spearfish Creek Alluvial Valley
Creek
Gulch
Belle Fourche Infiltration Gallery
Higgins
Spearfish
Developing Areas in Study Area
Interstate 90
0
1/4
1/2
1
miles
Spearfish Valley Sanitation District
Upper
Higgins
Gulch
City of Spearfish
Mountain
Plains
Christensen
Drive
N



0
1/4
1/2
1
miles
Spearfish
Creek
Higgins
Gulch
▨ Developing Areas
Belle Fourche
Infiltration Gallery
Weiss
Development
West
Development
spring
N

FIGURE 3-2

SPEARFISH CREEK ALLUVIAL VALLEY

TABLE 3-1

COST SUMMARY
INTERCEPTOR SEWER AND INDIVIDUAL TREATMENT ALTERNATIVES
WEST DEVELOPMENT

Alternative	Capital Cost	Life Years	Salvage Value	* Bond Requirements	O & M Cost	Total Annual Cost	Monthly Cost per tap
			Total Project				
Interceptor Sewer	$117,935	40	$58,960	$10,810	$ 3,000	$13,810	$ 44.25
Holding Tank							
Initial	18,000	20	0	1,650	11,580	13,230	183.75
Design	105,000	20	0	9,530	67,550	77,080	183.75
Evapotranspiration System							
Initial	36,000	20	0	3,300	4,020	7,320	101.70
Design	210,000	20	0	19,250	23,450	42,700	101.70
			Local Share				
** Interceptor Sewer	30,735	40	15,370	2,820	3,000	5,820	18.65
Holding Tank							
Initial	2,700	20	0	250	11,580	11,830	164.30
Design	15,750	20	0	1,440	67,550	68,990	164.30
*** Evapotranspiration System							
Initial	5,400	20	0	495	4,020	4,515	62.70
Design	31,500	20	0	2,890	23,450	26,340	62.70

* (6-5/8% - 20 years)
** 75% Federal Share
*** 85% Federal Share

SOURCE: Wastewater Facilities Plan. Spearfish, South Dakota. 1978

Upper Higgins Gulch

Residential developments included in Upper Higgins Gulch consist of the following subdivisions:

- MacKaben No. 1
- MacKaben No. 2
- DeBerg
- Grand View Acres
- Deer Meadows
- Westfield
- Hardy
- Fuller
- Old Tinton Road

These developments are shown on Figure 3-3.

Development in these areas has been at a rapid rate in recent years. All of the residences have on-site sewage disposal systems. The original Facility Plan states that these systems constitutes a threat to the quality of groundwater within the drainage area.

Several of the subdivisions have been located within or immediately adjacent to drainageways. This creates a potential hazard to dwellings and wastewater treatment systems during high runoff events. The potentially effected developments include: Deer Meadows No. 1 which is in the Higgins Gulch drainage, Westfield is located in the Johnston Gulch drainage, and DeBerg, Fuller, and MacKaben No. 1 are adjacent to drainages.

There are currently 88 homes in the developments in the Higgins Gulch drainage west of the City of Spearfish. The 20-year projected number of homes in the drainage is 370. The existing population of the subdivisions within the Higgins Gulch drainage area is 160 contributing approximately 16,000 gpd to the septic tank systems. A projected 20-year population for the drainage area is 1,100 people. Twenty-year design peak flow from the area is 165,000 gpd. It is estimated that an eight-inch interceptor sewer line would be adequate to convey the future wastewater flows from this area to the City system.

Original cost estimates of the three wastewater conveyance/treatment alternatives for Upper Higgins Gulch are summarized in Table 3-2. The original cost estimates did not include service for Grand View Acres, Hardy, or Old Tinton Road developments.

Mountain Plains

The Mountain Plains subdivision is adjacent to the southern border of the City of Spearfish. There are approximately ten homes in the development, all on individual disposal systems. There are currently 62 lots in the development. An additional filing on an additional 600 acres consisting

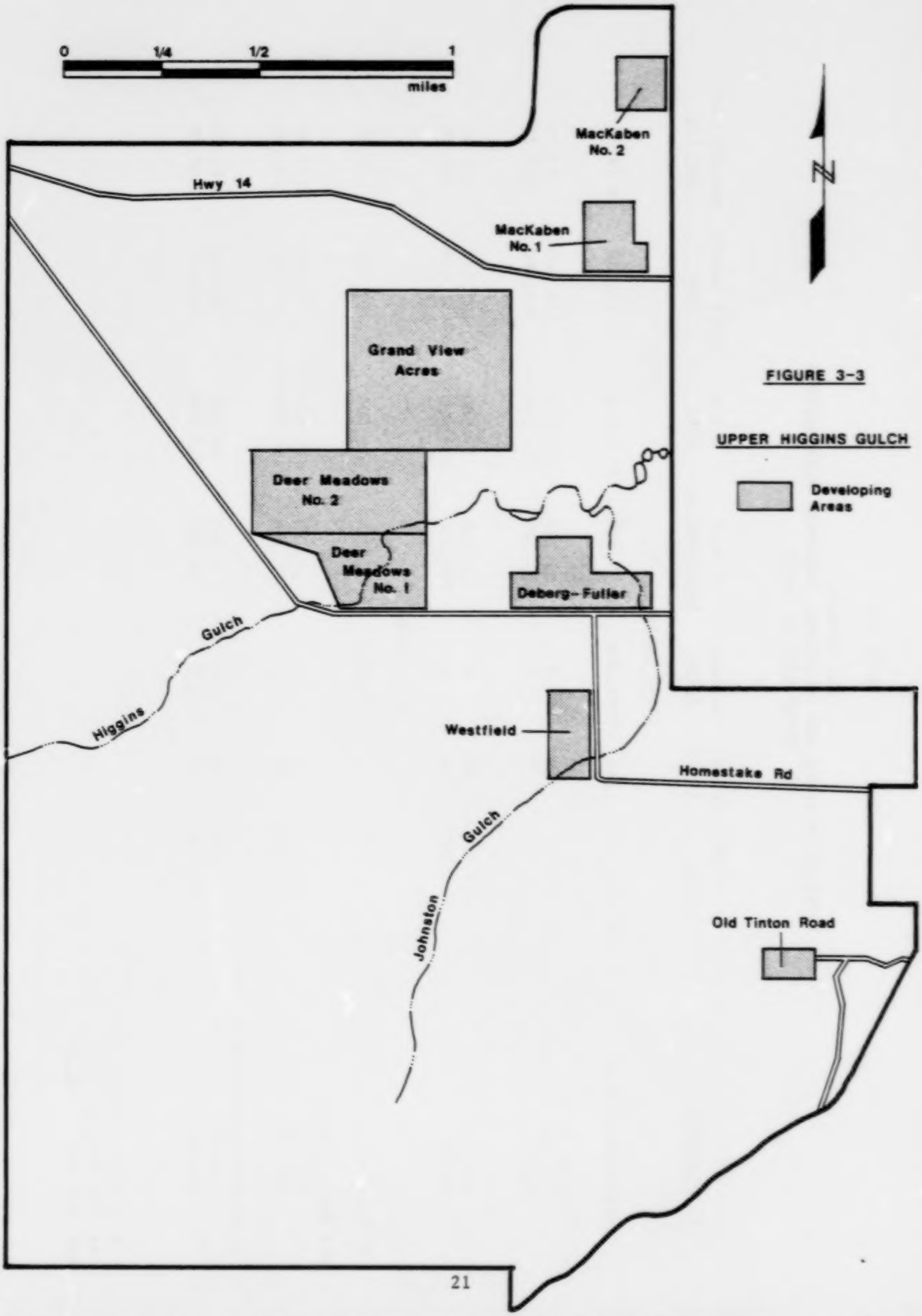

0
1/4
1/2
1
miles
N
MacKaben No. 2
Hwy 14
MacKaben No. 1
Grand View Acres
Deer Meadows No. 2
Deer Meadows No. 1
Deberg-Fuller
Higgins Gulch
Westfield
Homestake Rd
Johnston Gulch
Old Tinton Road
Developing Areas

FIGURE 3-3

UPPER HIGGINS GULCH

TABLE 3-2

COST SUMMARY
INTERCEPTOR SEWER AND INDIVIDUAL TREATMENT ALTERNATIVES
UPPER HIGGINS GULCH

Alternative	Capital Cost	Life Years	Salvage Value	* Bond Requirements	O & M Cost	Total Annual Cost	Monthly Cost per tap
Total Project							
Interceptor Sewer	$ 494,400	40	$247,200	$ 45,330	$ 5,000	$ 50,330	$ 18.35
Holding Tanks							
Initial	264,000	20	0	24,200	169,840	194,040	183.75
Design	1,110,000	20	0	101,780	714,100	815,880	183.75
Evapotranspiration System							
Initial	528,000	20	0	48,410	58,960	107,370	101.70
Design	2,220,000	20	0	203,550	247,900	451,450	101.70
Local Share							
** Interceptor Sewer	138,600	40	69,000	12,710	5,000	17,710	6.45
*** Holding Tanks							
Initial	39,600	20	0	3,630	169,840	173,470	164.30
Design	166,500	20	0	15,270	714,100	729,370	164.30
Evapotranspiration System							
Initial	79,200	20	0	7,260	58,960	66,220	62.70
Design	333,000	20	0	30,535	247,900	278,435	62.70

* (6-5/8% - 20 years)
** 75% Federal Share
*** 85% Federal Share

SOURCE: Wastewater Facilities Plan. Spearfish, South Dakota. 1978

of approximately 119 lots has been made. The subdivision lies on the Minnekahta Limestone formation. Seepage from individual wastewater treatment into the underlying groundwater may occur because Minnekahta Limestone is severely fractured. The subdivision lies above the Spearfish Creek drainage. Effluent from the individual wastewater treatment facilities within the development could reach the surface water of Spearfish Creek by traveling through fractures in the limestone formation. (See Figure 3-4).

Twenty-year population projection is 280 people. Twenty-year design peak flow is 42,000 gpd. An eight-inch interceptor would be of adequate size to service the area for the interceptor sewer alternative.

Original cost estimates for the interceptor and on-site treatement alternatives are presented in Table 3-3.

Christensen Drive

The Christensen Drive Subdivision is located southeast of the City of Spearfish. The development consists of 28 residential units and two large campgrounds. The campgrounds (Chris' and Mountain View) support a summertime population of 250 people. Sewage disposal is accomplished by individual, on-site systems.

Septic tank systems used for wastewater treatment appear to be overloaded during the summer months. Contamination of the groundwater within the drainage area has been documented (2) by test results of water from a domestic water well at the Miller Ranch. (See Figure 3-5).

Based on a design peak flow of 25,000 gpd during the peak summertime loads an eight-inch sewer line would handle sewage flow.

Presented in Table 3-4 is a summary of the original cost estimates for the conveyance/treatment alternatives the facilities plan considered for Christensen Drive.

No Action

The no action alternative for the outlying areas was summarily dismissed in the 1978 facilities plan because of the potential contamination of groundwater which could create a risk of disease transmission associated with the use of shallow domestic water wells.

Initial Recommendation

The original facilities plan, after evaluating the economic, environmental, and social implications of a comprehensive wastewater treatment disposal plan makes the following recommendations for the outlying areas:

FIGURE 3-4

MOUNTAIN PLAINS

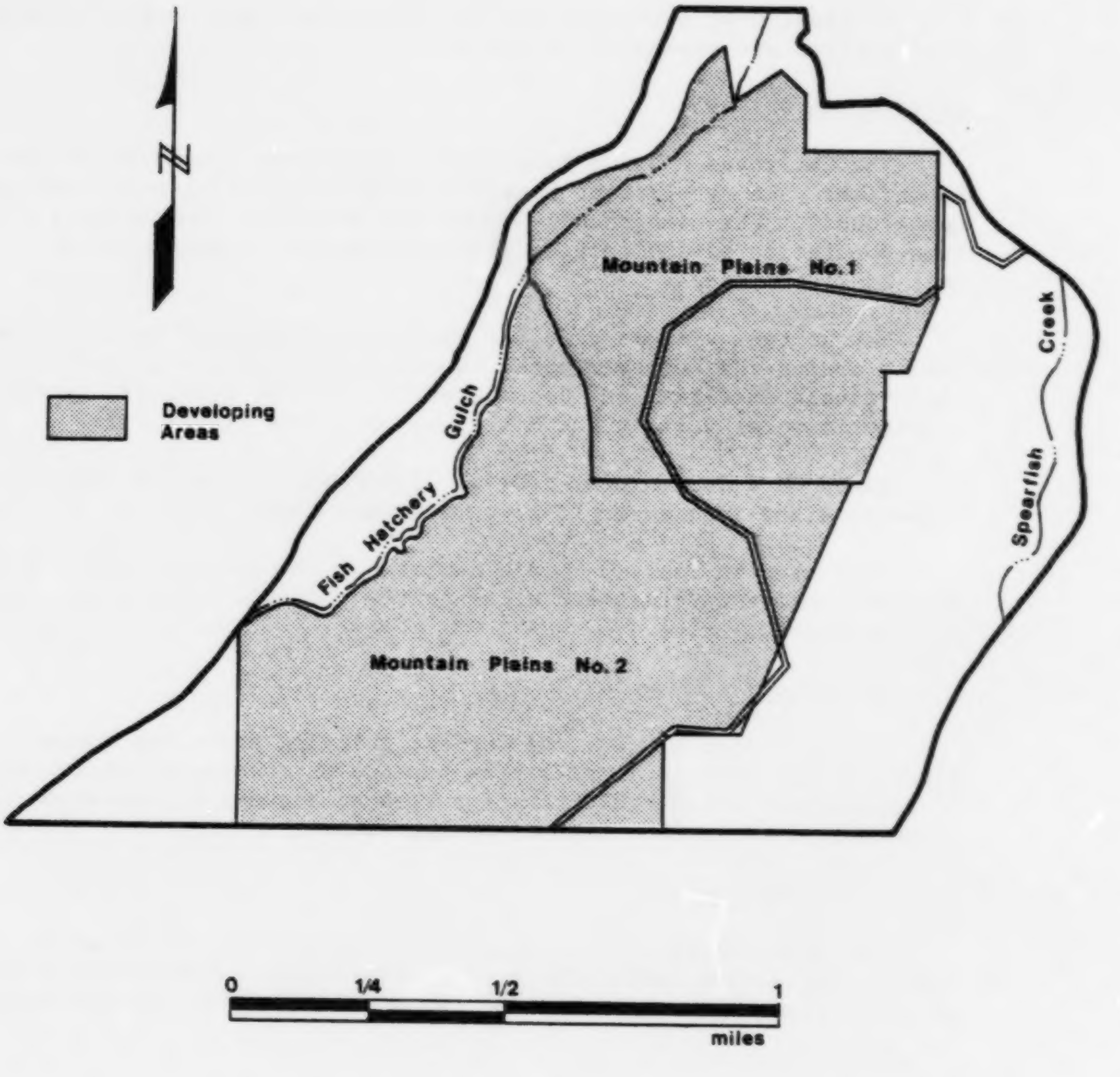

N
Developing Areas
Mountain Plains No.1
Mountain Plains No. 2
Fish Hatchery Gulch
Spearfish Creek
0
1/4
1/2
1
miles

TABLE 3-3

COST SUMMARY
INTERCEPTOR SEWER AND INDIVIDUAL TREATMENT ALTERNATIVES
MOUNTAIN PLAINS

Alternative	Capital Cost	Life Years	Salvage Value	* Bond Requirements	O & M Cost	Total Annual Cost	Monthly Cost per tap
			Total Project				
Interceptor Sewer	$274,820	40	$137,410	$25,200	$ 2,500	$ 27,700	$ 42.00
Holding Tanks							
Initial	60,000	20	0	5,500	38,600	44.100	183.75
Design	285,000	20	0	26,130	183,350	209,480	183.75
Evapotranspiration System							
Initial	120,000	20	0	11,000	13,400	24,400	101.70
Design	570,000	20	0	52,260	63,650	115,910	101.70
			Local Share				
** Interceptor Sewer	68,710	40	0	6,300	2,500	8,800	13.35
*** Holding Tanks							
Initial	9,000	20	0	830	38,600	39,430	164.30
Design	42,750	20	0	3,920	183,350	187,270	164.30
*** Evapotranspiration System							
Initial	18,000	20	0	1,650	13,400	15,050	62.70
Design	85,500	20	0	7,840	63,650	71,490	62.70

* (6-5/8% - 20 years)
** 75% Federal Share
*** 85% Federal Share

SOURCE: Wastewater Facilities Plan. Spearfish, South Dakota. 1978

FIGURE 3-5

CHRISTENSEN DRIVE

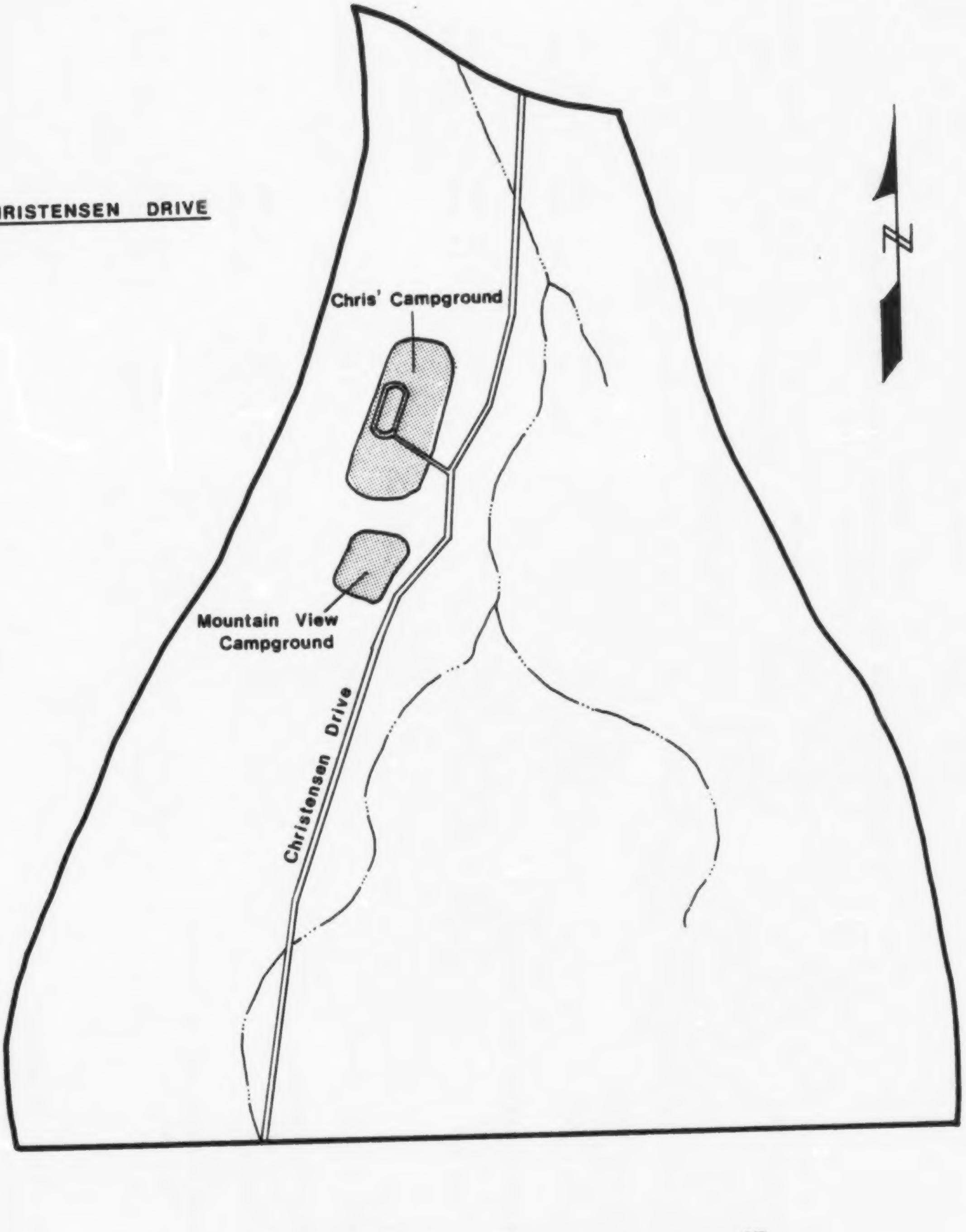

Chris' Campground
Mountain View Campground
Christensen Drive
N
0
1/8
1/4
1/2
miles

TABLE 3-4

COST SUMMARY
INTERCEPTOR SEWER AND INDIVIDUAL TREATMENT ALTERNATIVES
CHRISTENSEN DRIVE

Alternative	Capital Cost	Life Years	Salvage Value	* Bond Requirements	O & M Cost	Total Annual Cost	Monthly Cost per tap
			Total Project				
Interceptor Sewer	$57,220	40	$28,600	$ 5,250	$ 1,000	$ 6,250	$ 13.50
Holding Tanks							
Initial	81,000	20	0	7,430	52,380	59,810	184.60
Design	150,000	20	0	13,750	97,000	110,750	184.60
Evapotranspiration System							
Initial	162,000	20	0	14,850	18,230	33,080	102.10
Design	300,000	20	0	27,510	33,750	61,260	102.10
			Local Share				
** Interceptor Sewer	$ 14,305	40	$ 7,150	$ 1,315	$ 1,000	$ 2,315	$ 5.10
*** Holding Tanks							
Initial	12,150	20	0	1,115	52,380	53,495	165.10
Design	22,500	20	0	2,065	97,000	99,065	165.10
*** Evapotranspiration System							
Initial	24,300	20	0	2,230	18,230	20,460	63.15
Design	45,000	20	0	4,130	33,750	37,880	63.15

* (6-5/8% - 20 yrs.)
** 75% Federal Share
*** 85% Federal Share

SOURCE: Wastewater Facilities Plan. Spearfish, South Dakota. 1978

- Interceptor sewers be constructed to service all of the major developments in the outlying areas that are threatening the quality of the local groundwater by discharges from septic tank - leach field systems.
- No septic tank-leach field treatment systems be allowed within the Planning Area. Isolated homes that cannot be economically connected to the sewer collection system must install self-contained treatment sytems approved by a registered professional engineer.
- A Spearfish Sanitation District be established to include the thirty-one square mile Planning Area. The prime responsibilities of this governing body would be to manage the existing wastewater collection and treatment facilities, to establish regulations for construction of new treatment facilities, to collect sewer use charges and/or taxes, and enforce the established regulations.
- Additional staffing be provided to the offices of the Northern Hills Sanitarian and Lawrence County Planning and Zoning to provide more scrutiny in the issuring of building permits and in the construction of individual wastewater treatment facilities within the Planning Area.

ALTERNATIVES UPDATE

The original Facilities Plan concludes that septic tank - leach fields are a source of contamination to groundwaters and potable drinking waters in the Spearfish Creek and Higgins Gulch alluvial drainage and that development in the Study Area has been haphazard with no planning as to location of development in relation to floodplains or with regard to proper wastewater treatment and disposal.

The update of the Facilities Plan and this EIS focus on wastewater disposal, potential groundwater and surface water contamination, and development policies. This analysis is based on the information collected, analyzed, and presented in Appendix A, Existing Data Base Evaluation, Spearfish, South Dakota, which was distributed for review to the Citizens Advisory Committee, the City of Spearfish, the City of Belle Fourche, Lawrence County and the South Dakota Department of Natural Resources in August 1979.

Spearfish Creek Alluvial Valley

Septic tanks in the Spearfish Creek Alluvial Valley are believed to be a contributor (along with nonpoint sources) to the contamination of the Belle Fourche water supply. Because of the high groundwater levels and potential flood hazards associated with this area, the following alternatives are identified as suited for wastewater collection and disposal:

- Gravity collection and pressure interceptor line to the City of Spearfish system.
- Pressure effluent collection system from septic tanks connected to the Hope Weiss treatment plant and pumped to the City's system.
- Gravity collection conveyed to the Hope Weiss treatment plant.

Upgrading Existing Septic Tanks

Two failing septic tank systems have been identified through the use of aerial imagery. One system had no leach field and was discharging effluent directly to Higgins Gulch. A leach field in conformance with South Dakota regulations has recently been installed for this system the second system is exhibiting surfacing of effluent. Available information on the system indicates the leach field is undersized for a two bedroom home and local soil conditions. It is estimated that an additional 250 square feet (80 linear feet) of leach field is required. Assuming an average cost of $6 a linear foot for leach field piping, the upgrading costs will be about $480.

Twelve septic tank systems have been identified as suspected of being seasonal failures. During periods of heavy rainfall saturation of heavy clay soils in the bench area of Upper Higgins Gulch may cause septic tank effluent surfacing. The 12 suspected failures are located throughout the Study Area, all on impermeable clay soils. It is recommended that these systems be monitored during spring and summer rainfall periods by the Northern Hills Sanitarian to verify any failures. Those systems not failing are functioning as evapotranspiration systems. Those systems found to be failing are to be upgraded under the direction of the Northern Hills Sanitarian or by the Department of Natural Resources to eliminate the health hazards associated with surfacing effluent.

A survey conducted by Scott Engineers showed that all 12 of the leach fields of the suspected failing systems are underdesigned. In the event that all 12 systems are verified as failing it is possible that complete replacement of the leach fields will be required at the owner's expense.

There were an additional 45 septic tank systems identified using aerial imagery as suspected failures. Field inspection of these systems concluded that thirty-three are functioning as evapotranspiration systems and not creating a public health hazard and 12 are false indications, not associated with the on-site disposal systems (artesian wells or roof drains.)

AFFECTED ENVIRONMENT

CHAPTER 4

CHAPTER 4

AFFECTED ENVIRONMENT

Spearfish, South Dakota is located on the northern edge of the Black Hills in Lawrence County. The proximity to the Black Hills and the Spearfish Creek Valley offers a year round focal point for recreational activities. Along with the recreational opportunities Spearfish is an area which is experiencing energy related growth. These two features of the area will continue to contribute to the growth and development of the area.

The Study Area is approximately 31 square miles and includes the City of Spearfish and the surrounding environs. The Study Area has been divided into the following subareas.

- Spearfish Creek Alluvial Valley
- Upper Higgins Gulch
- Mountain Plains
- Christensen Drive

These four areas represent the outlying areas and exclude the City of Spearfish and the Spearfish Valley Sanitation District.

POPULATION AND LAND USE

The 1977 population estimate for the outlying area is estimated to be 700 people (2) and the 1998 projection is 3,230. According to the Lawrence County Planning and Zoning Administrator (3) there will be approximately 2950 homesites needed by 1998 for the entire Study Area. The housing market in the Study Area is expected to be oriented toward small acreages and not land efficient development. This type of development in outlying areas will tend to encourage the use of on-site wastewater treatment systems.

Assuming that a 1970 family income of $10,000 or more is considered in the upper income group, 30 percent of the families in Spearfish would have an upper level income (See Table 4-1). Projecting this percentage to future populations there is expected to be about 880 upper level income families in the area or 880 upper level income homesites required.

Virtually all of the homesites available in the outlying areas are large lots which will require upper level income earnings to finance the land and home construction.

TABLE 4-1

1970 FAMILY INCOME DISTRIBUTION

SPEARFISH, SOUTH DAKOTA

Income, $	Families	Percent of Total
Less than 3,000	119	12.0
3,000 to 4,999	159	16.0
5,000 to 6,999	163	16.4
7,000 to 9,999	247	24.9
10,000 to 14,999	191	19.3
15,000 to 24,999	105	10.6
25,000 or more	8	0.8

There are currently between 300 and 350 available homesites in the outlying areas, excluding the Spearfish Valley Sanitation District. These homesites are roughly distributed as follows:

Spearfish Creek Alluvial Valley	30 sites
Upper Higgins Gulch	110 sites
Mountain Plains	160 sites
Christensen Drive	40 sites

It is expected that these available homesites will be developed during the next twenty years. Based on the assumed need for 880 homesites there will be a shortage of about 540 homesites.

At this time it is not possible to project the distribution of these additional 540 homesites in the outlying areas.

The dominate land use of the outlying area is agricultural (grazing). Land use has been identified by the South Dakota State Planning Bureau in cooperation with the Sixth District Council of Governments. (5)

The Spearfish Creek Alluvial Valley

There are two developments in the Spearfish Creek Alluvial Valley, the West development and Hope Weiss development, with some scattered development. The West-Weiss development consists of single family dwellings.

With the exception of one dwelling, the Hope Weiss development is connected to the City of Spearfish's sewer system via a privately owned sewer line which is preceded by a small wastewater treatment plant. The remaining developments in the area are on individual sewage disposal systems.

Upper Higgins Gulch

Residential development in this area consists of the following subdivisions:

- MacKaben No. 1
- MacKaben No. 2
- DeBerg
- Grand View Acres
- Deer Meadows
- Westfield
- Hardy
- Fuller
- Old Tinton Road

MacKaben No. 1 and MacKaben No. 2 have 25 and 12 residences, respectively. In the Deberg and Fuller developments there are about 20 homes. Grand View Acres currently has 12 homes, Deer Meadows has 15 to 20 homes, and Westfield has about 15 homes. All of these residences have on-site sewage disposal systems.

Not all of the lots in Upper Higgins Gulch have been developed, thus maximum density has not yet occurred. It is anticipated that this area will continue to develop as demonstrated by a recent filing of an additional 80 acres for Deer Meadows No. 2.

In the Deberg development platted lots range in size from 1.92 acres to 0.51 acre. Four of the lots are 0.78 acre, two are 0.51 acre, and one is 0.63 acre. In the Fuller addition, 12 plotted lots range in size from 2.57 acres to 0.61 acre. Of these lots, four are 0.61 acre, four are 0.62 acre, and three are 0.95, 0.74, and 0.70.

Platted lots in the existing Deer Meadows development and Grand View Acres are all larger than 1.0 acre. The Westfield development has 35 platted lots which vary in size from 0.46 acre to 0.60 acre.

Data on the remaining subdivisions lot size were not available.

Those areas which are not currently developed are used for livestock grazing and are expected to continue under this use until development is deemed feasible by the land owner.

Mountain Plains

The Mountain Plains subdivision is adjacent to the southern border of the City of Spearfish. There are about 10 homes in the development, all on individual disposal systems. There are currently 62 lots in the development and an additional filing on an additional 600 acres has been made. This area is expected to develop into larger lots of several acres. Development is likely to be slow due to the much higher costs of development.

Christensen Drive

The Christensen Drive development is located southeast of the City of Spearfish. The development consists of 28 residential units and two large campgrounds. Sewage disposal is accomplished by individual, on-site systems.

CLIMATE

The Study Area has a continental climate, experiencing extreme fluctuations in temperature in both summer and winter. The summer and winter annual average temperature is 46.5 F and 35.8 F, respectively. Winds in the area are generally from the north-northwest at an average velocity of 10 to 12 miles per hour. Spring and summer winds frequently blow from the south-southeast with velocities up to 75 miles per hour.

The average annual precipitation is 20.2 inches. The highest monthly precipitation occurs during April, May, June, and July. Most of the seasonal precipitation occurs as short duration, high intensity thunderstorms. Climatological data are further presented in Appendix A.

GEOLOGY

Nine geologic formations have been identified within the Study Area. (2) The identified formations consist of recent alluvial deposits, old terrace deposits, the Spearfish Formation, Morrison Shale, the Sundance Formation, the Minnelusa Formation, Opeche Shale, Minnekahta Limestone and the Brule Clay.

The recent alluvial deposits are found in the Spearfish Creek and Higgins Gulch bottom lands. The alluvial material consists of silt, sand, gravel, and cobbles. These deposits have a high permeability, partially a consequence of their unconsolidated nature and also as a result of historic stream channels. The old stream channels meandering through the subsurface alluvium are confined to the broad bottom lands of Spearfish Creek. It is within these recent alluvial deposits that the City of Belle Fourche has located its water supply infiltration gallery.

Old terrace deposits occur as isolated outcrops along the edge of the benches of the bottom lands. These deposits are of a similar material as the recent alluvial deposits but are older. Because of the location of these old terrace deposits relative to the Spearfish formation it is thought that these areas may contain perched water tables which would not be contiguous with other groundwater in the area.

The Spearfish Formation underlies the alluvial deposits of the major drainages of the Study Area. This formation is found to be the dominant formation of the benches above the bottomland areas. The Spearfish Formation is predominately a red siltstone, consisting of red sandy or silty shale. Massive gypsum beds and stringers occur throughout the formation and limestone outcrops are also found. There are also areas of gravel and unconsolidated sand which may be remnants of old terrace deposits. The Spearfish Formation is considered to be a very impermeable material, having a low water yielding capacity.

The Morrison Shale is found on the uppermost areas of the Lookout Peak area east of Spearfish. This formation has little significance in this study because of its location.

The Sundance formation separates the Spearfish Formation and the Morrison Shale in the eastern mountains of the Study Area. This is a shale which has some sand beds within the formation.

The Minnelusa Formation consists of pink and white granular sandstones with limestone lenses and layers. Red shales, white sandstone and interbedded limestone occur near the base. In some areas a thick permeable sand is found at the top of the formation. This formation surfaces in the mountains south and southwest in the Study Area. This material is permeable and where it outcrops serves as an area for groundwater recharge. Groundwater of the Minnelusa is significant to the area because of its good quality, its artesian characteristics and high yield.

The Opeche Formation is composed of red silty and sandy shales and may contain streaks of gypsum. The formation is found in the western areas of the Study Area.

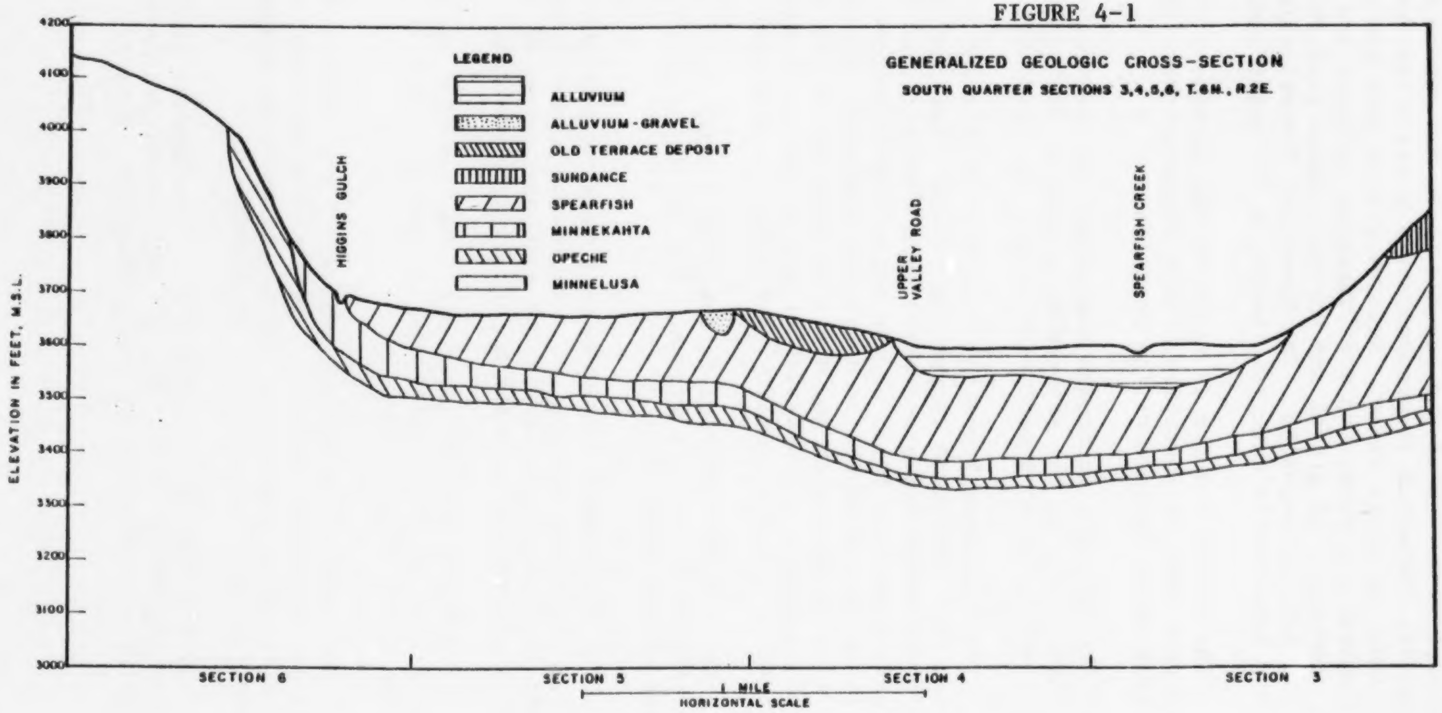
The Minnekahta Formation is a massive gray and pink laminated limestone. Solution caverns and sinks occur in the formation. This sedimentary layer is found primarily in the southwest areas of the Study Area, underlies the Spearfish formation, and is more permeable than the Spearfish.

The Brule Clay is a remnant formation that is considered to be insignificant to this study. The formation occurs in the southeast corner of the Study Area.

The general dip of the geologic formations is northeast and varies from one to three degrees. A generalized geologic cross-section is illustrated on Figure 4-1. An idealized stratigraphic section of these formations is also indicated on Figure 4-1.

In the context of water quality management and the use of absorption fields for septic tanks, key geologic considerations include the depth to bedrock, the potential for groundwater recharge, and soil type.

FIGURE 4-1


GENERALIZED GEOLOGIC CROSS-SECTION
SOUTH QUARTER SECTIONS 3,4,5,6, T.6N., R.2E.
LEGEND
ALLUVIUM
ALLUVIUM-GRAVEL
OLD TERRACE DEPOSIT
SUNDANCE
SPEARFISH
MINNEKAHTA
OPECHE
MINNELUSA
HIGGINS GULCH
UPPER VALLEY ROAD
SPEARFISH CREEK
ELEVATION IN FEET, M.S.L.
4200
4100
4000
3900
3800
3700
3600
3500
3400
3300
3200
3100
3000
SECTION 6
SECTION 5
SECTION 4
SECTION 3
1 MILE
HORIZONTAL SCALE

The following summarizes the location of subdivisions as they relate to the identified geologic formation.

- Spearfish Creek Alluvial Valley
  - Weiss-West developments - recent alluvial deposits
- Upper Higgins Gulch
  - Hardy - recent alluvial deposits
  - MacKaben No. 1 - recent alluvial deposits and the Spearfish formation
  - MacKaben No. 2 - older terrace deposits and the Spearfish formation
  - Deer Meadows - recent alluvial deposits and the Spearfish formation
  - Deberg-Fuller - recent alluvial deposits and the Spearfish formation
  - Grandview Acres - older terrace deposits and the Spearfish formation
  - Westfield - older terrace deposits
  - Old Tinton Road - Minnekahta Limestone
- Mountain Plains - Minnekahta Limestone
- Christensen Drive - Spearfish Formation

SOILS

The U. S. Soil Conservation Service (SCS) has completed the survey program necessary to map and interpret the soils of Lawrence County. (6) Within the Study Area a total of 36 soils have been identified. The soils map and the soils descriptions are currently unpublished. However, the unpublished soils maps and interpretations were made available from the South Dakota State Planning Bureau (SDSPB). The detailed soils data contain several variables relative to land development and use including, water management, soil and water features (surface and groundwater), suitability for sanitary facilities, building site development, physical and chemcial properties of soil, soil use as a construction material, crop and pasture production, recreational development, engineering properties, windbreaks and environmental plantings, woodland management and productivity, and wildlife habitat potentials. For the purpose of this Study those variables pertinent to urban/suburban development and associated wastewater disposal are evaluated and presented in Appendix A.

Land development outside the City limits of Spearfish has been predominately north and northwest, with some development west and southwest. The developments have occurred on many different types of soils, some suitable to residential use and some having suitability constraints.

The following is a summary of soils that occur in the various subareas. For a more detailed description of the soils of the Study Area see Appendix A.

Spearfish Creek Alluvial Valley

Weiss-West

The Weiss-West developments are located in an area which consists of four major soils:

- Barnum silt loam
- Barnum silt loam, channeled
- Swint silt loam
- St. Onge loam

All four soils are susceptible to occasional flooding and have been determined to have severe limitations for septic tanks, sewage lagoons, and building site development.

Upper Higgins Gulch

Hardy

The Hardy development is located on the transition area from the eastern edge of Section 32. It is situated on the following four soils:

- Vale silt loam, 0 to 2 percent slopes
- Vale silt loam, 2 to 6 percent slopes
- Tilform silt loam, 6 to 9 percent slopes
- Nevee silt loam, 6 to 9 percent slopes

The Hardy development is located on the transition area from bottomlands to the bench area. The Nevee soils have low strength and buildings may require foundations and footings designed to deal with potential problems to prevent structure damage. The remaining soils are well suited for building. Slow percolation of the Vale, and Nevee soils may require that septic tank absorption fields be enlarged. Absorption fields in the Nevee soil may not be feasible in places due to a shallow depth to bedrock (40 to 60 inches) which can outcrop in this transitional area between the alluvium and the bench area.

MacKaben No. 1

The MacKaben No. 1 subdivision is located on the southside of Interstate 90 in the southeast quarter of Section 32. The subdivision is in the Higgins Gulch drainage and Higgins Gulch crosses through the northern edge of the subdivision. There are four soil types in the subdivision, these include:

- Winetti cobbly loam
- Tiltford silt loam, 2 to 6 percent slopes
- Tiltford silt loam 6 to 9 percent slopes
- Vale silt loam, 2 to 6 percent slopes

The Tilford soils found in the MacKaben subdivision are well suited for both building sites and septic tank leach fields. The Vale soil is suited for building but it is suggested by SCS that septic tank leach fields be enlarged due to slow percolation rates. The Winetti soil is identified as unsuited for building sites and sanitary facilities because of the potential for flooding and seepage problems.

MacKaben No. 2

The MacKaben No. 2 subdivision is located in the southwest quarter of Section 5 and part of the southeast quarter of Section 6. There are 15 to 20 residential units in the subdivision. There are 6 soil types found in the subdivision:

- Barnum silt loam
- Rekop-Gypnevee-Rock outcrop complex, 15 to 50 percent slopes
- Nevee-Spearfish-Rock outcrop complex, 9 to 40 percent slopes
- Swint silt loam
- Vale silt loam, 2 to 6 percent slopes
- Nevee silt loam, 2 to 6 percent slopes

The Barnum soil is generally not suited for building sites and sanitary facilities due to the potential for occasional flooding. The shallow depth to bedrock, low strength, and presence of soluble gypsum make the Rekop-Gynevee-Rock outcrop complex undesirable for building sites and septic tank leach fields. Building sites and sanitary facilities should be located on the lower slopes of the Nevee-Spearfish-Rock outcrop complex. If buildings are constructed on this unit proper design of foundations and footings should occur to help prevent structure damage caused by the low strength of these soils. Septic tank absorption fields should be located on the Nevee soils if possible. Enlarging the filter fields helps overcome the slow percolation rate. The potential for occasional flooding may render the Swint soil undesirable for both building sites and septic tanks, while the Vale soil is well suited for building sites but enlargement of septic tank leach fields may be required to overcome the slow percolation rate. The low strength of the Nevee soil, slow percolation rate and depth to bedrock may limit development on the soil.

Deberg-Fuller

The Deberg-Fuller subdivision is located in the southeast quarter of Section 5. There are 20 residences in the subdivision. The four soil types found in the subdivision include:

- Nevee-Spearfish-Rock outcrop complex, 9 to 40 percent slopes
- Tilford silt loam, 2 to 6 percent slopes
- Tilford silt loam, 6 to 9 percent slopes
- Vale silt loam, 0 to 2 percent slopes

The Nevee-Spearfish-Rock outcrop complex is best suited for development and septic tanks on the lower slopes of the unit. Proper design of foundation and footings helps prevent structure damage caused by the low strength of these soils. Septic tank absorption fields should be located on the Nevee soils where possible. Enlarging the filter field helps overcome the slow percolation rate. The Tilford soils are well suited for both building sites and septic tank absorption fields. The Vale soil is well suited for building sites but septic tank absorption fields may require enlarging to overcome slow percolation rates.

GrandView Acres

The GrandView Acres subdivision is located in the northwest quarter of Section 5 and contains 12 residential units. An unnamed intermittent creek runs through the center of the subdivision. The principal soil types which occur within the subdivision are:

- Nevee-Spearfish-Rock outcrop complex
- Tilford silt loam, 2 to 6 percent slopes
- Tilford silt loam, 6 to 9 percent slopes
- Vale silt loam, 0 to 2 percent slopes
- Vale silt loam, 2 to 6 percent slopes
- Nevee silt loam, 2 to 6 percent slopes

Residential development on the Nevee-Spearfish-Rock outcrop complex should be located on the lower slopes in this unit. Proper design of foundations and footings helps prevent structure damage caused by low strength of these soils. Septic tank absorption fields should be located on the Nevee soils and the fields should be enlarged due to slow percolation rates. The Tilford soils have no constraints for development. The Vale soils are well suited for development but for septic tanks it is recommended that enlarged absorption fields be built to offset slow percolation rates. Nevee soils are not well suited for building due to the low strength of the soils, slow percolation rates, and depth to bedrock.

Westfield

Located in the northeast quarter of Section 8, the Westfield development consists of 15 units. There are three soil types in the subdivision. These soils are:

- Winetti cobbly loam
- Tilford silt loam, 2 to 6 percent slopes
- Tilford silt loam, 6 to 9 percent slopes

The Winetti soil is not suited to building sites or septic tanks because of the potential for flooding and seepage. However, the Tilford soils are suitable for both building sites and septic tanks.

Old Tinton Road

The Old Tinton Road, west of Spearfish, has undergone limited development. There are currently 10 to 12 residential units in this area. These units are constructed on the following soil types:

- Vale silt loam
- Paunsaugunt-Rock outcrop

The major constraints for development on these soils include slow percolation rate and potential shallow depth to bedrock for septic tank absorption fields. Enlarging the size of the absorption field helps overcome slow percolation.

Mountain Plains

The Mountain Plains subdivision is located in the southern part of Section 22. There are about 10 residences in the development. There are three major soil types in the area and include the following:

- Paunsaugunt-Rock outcrop complex
- Vanocker-Citadel association
- Citadel association

Steep slopes, stoniness and shallow depth to bedrock make the Paunsaugunt-Rock outcrop complex unsuited for building sites and septic tanks. Steep slopes, and an associated potential for soil slippage makes the Vanocker-Citadel association unsuited for development. The Citadel association can be built on if measures are taken to overcome the potential for shrinking and swelling of this soil. Enlarging the septic tank absorption field helps overcome slow percolation. SCS suggests that if buildings and septic tanks are constructed, they should be located in the lower part of the landscape where slopes are less steep.

Christensen Drive

There are few homes in the Christensen Drive development and two campgrounds. These developments have occurred on the following soils:

- Nevee-Spearfish-Rock outcrop complex
- St. Onge, loam
- Vale, silt loam, 2 to 6 percent slopes
- Vale, silt loam, 6 to 9 percent slopes

The Vale silt loams are well suited as a site for building with the following precaution; septic tank absorption fields may need to be enlarged to help overcome the slow percolation rate. Residential development on the Nevee-Spearfish-Rock outcrop complex should be located on the lower slopes of this unit. Proper design of foundations and footings helps prevent structure damage caused by low strength of these soils. Septic tank absorption fields should be located on the Nevee soils and the leach fields should be enlarged due to slow percolation rates. The St. Onge loam is susceptible to occasional flooding and has been determined to have severe limitations for septic tanks, sewage lagoons, and building site development.

WATER QUALITY CRITERIA AND STREAM CLASSIFICATION

The State of South Dakota has promulgated surface water quality standards pursuant to the Clean Water Act. Numeric criteria have been established for 28 parameters/constituents to result in achieving 12 beneficial uses. The beneficial uses and criteria for surface waters are presented in Appendix A. Beneficial uses of all streams in South Dakota are designed for irrigation and wildlife propagation and stock watering. Within the Study Area only Spearfish Creek and Higgins Gulch are designated for additional beneficial uses. Spearfish Creek from the Redwater River to the Homestake Hydroelectric Plant discharge is designated for domestic water supply, cold water permanent fish life propagation, immersion recreation water, and limited contact recreation waters. Above the Homestake Hydroelectric Plant to the Study Area boundary Spearfish Creek is designed for cold water marginal fish life propagation and limited contact recreation. Higgins Gulch from its confluence with Spearfish Creek to the Study Area boundary is designated for cold water permanent fish life propagation and limited contact recreation.

WATER QUALITY

Surface and groundwater quality have been monitored extensively throughout the Study Area. The principal sources of water quality data are:

- U.S. Geological Survey-Water Resources Division
- U.S. Environmental Protection Agency
- South Dakota Department of Environmental Protection
- South Dakota Department of Natural Resources
- Special Studies

The most comprehensive data, which concentrates on the area of the Higgins Gulch-Spearfish Creek confluence are available from a series of special studies. These studies have resulted in the identification of water quality problems in the surface waters of Higgins Gulch, and Spearfish Creek, and in the groundwater of the alluvium which is the source of the Belle Fourche water supply.

Coliform bacteria has been the critical water quality parameter. Total and fecal coliforms are biological indicators of pollution. These organisms serve as indicators for the presence of potentially hazardous waterborne disease. Fecal coliform constitute about 90 percent of the coliforms discharged in fecal matter whereas total coliforms account for organisms naturally originating in soil, grain, and decaying vegetation. The presence of fecal contamination is a recognized means of indicating a potential hazard for human consumption. A high total coliform population is also a suspicious symptom but not a specific indication of fecal pollution. Other significant water quality parameters which have been monitored include: chloride, nitrate, sodium, and total dissolved solids (TDS).

Water quality problems were first identified at the Belle Fourche infiltration gallery in 1967. Sporadic contamination was reported from 1967 to 1977. Consistent contamination of the gallery was reported in the last half of 1978 but during 1979 no contamination was reported. In addition, a shallow well at the mouth of Christensen Drive has been abandoned for domestic use due to coliform contamination.

Surface water quality data for coliform bacteria are the most comprehensive for 1978. Spearfish Creek and Higgins Gulch have had high coliform counts during the summer and fall of 1978.

Groundwater flows down Higgins Gulch into the Spearfish Creek Alluvial Valley. In the area south of the infiltration gallery, the groundwater moves in a northeasterly direction from Higgins Gulch into the gallery area. The gallery area is also recharged from surface water from Spearfish Creek. Higgins Gulch surface drainage is also recharging the groundwater as evidenced by surface flows disappearing into the permeable streambed above the gallery area (1).

Studies at the City of Belle Fourche's infiltration gallery in the fall of 1978 indicate that the depth of the groundwater varies from one foot to over ten feet below the surface. These data were collected in the fall, and therefore may not reflect the seasonally high groundwater. Well log data for areas outside the gallery area indicate that the depth to the static water table range from 15 to 25 feet below the surface.

In 1979 a special investigation was conducted to further quantify groundwater levels in the area. (1) Water levels south of Interstate 90 (Upper Higgins Gulch) were found to be greater than 15 feet below the ground surface. North of the Interstate groundwater became shallower with the highest water levels recorded around the Belle Fourche infiltration gallery in the Spearfish Creek Alluvial Valley.

The increase in the number of septic tank-leach fields associated with development in the Higgins Gulch area has been suspected as the cause of the water quality problems identified at the Belle Fourche infiltration gallery. However, recent studies have demonstrated that percolation through 120 centimeters (cm) (4 feet) of soil appears to be sufficient to minimize the possibility of groundwater pollution by fecal coliform or viruses (coliphages) from septic effluent disposal (15).

Concentrations of chloride, nitrate, sodium, and TDS in the Study Area are not high enough to warrant a concern for water use, they do indicate that septic tank effluents are entering the groundwater of the Study Area. This situation is anticipated since soil absorption fields usually do not change mineral concentrations.

Sewage disposal by septic tanks and absorption field is practiced at the West Development and by one home in the Weiss Development which are within a few hundred feet of the infiltration gallery. These systems are located in the same alluvial deposits that the City of Belle Fourche has their infiltration gallery.

All of the remaining outlying areas accomplish sewage disposal by on-site systems, primarily conventional septic tanks followed by soil absorption fields. The closest concentration of developments outside of the Spearfish Creek Alluvial Valley using septic systems are in the Higgins Gulch area, about three miles away from the gallery. These developments are located on the Spearfish Creek bench areas. Soils, according to SCS, are of a clay-loam and because of their slow permeabilities are not suited for septic tank leach fields unless the leach fields are enlarged.

Septic tank systems suspected of failing were identified using aerial imagery. Two of the systems suspected as failing were confirmed as actual failures and 13 were identified as potentially failing during wet periods. These 15 systems were identified through surface manifestations (lush vegetation over leach field) indicating tight, impervious soils which are inhibiting effluent percolation.

Further analysis of the water quality data from selected stations indicate that there is a correlation between rainfall events (monitored at the Homestake Saw Mill) and coliform counts in Higgins Gulch, Spearfish Creek, the Spearfish Creek Alluvial Valley, and the Belle Fourche infiltration gallery.

The selected monitoring stations are shown in Figure 4-2. Data from these monitoring stations and precipitations recorded at the Homestake Saw Mill are presented in Tables 4-2 through 4-6 for the summer and fall of 1978. From this information the following correlations and conclusions are made:

- 20 out of 29 of the total coliform samples collected in the Spearfish Creek Alluvial Valley (infiltration gallery, Cundy drain) were associated with rainfall events.
- 31 out of 33 of the fecal coliform samples collected in the Spearfish Creek Alluvial Valley were associated with rainfall events.
- Total coliform counts in Higgins Gulch were generally higher after rainfall events.
- Fecal coliform counts in Higgins Gulch do not exhibit a defined trend. Counts ranged from 5 per 100 ml. to 276 per 100 ml.
- Total coliform data in Spearfish Creek were insufficient to evaluate.
- Fecal coliform counts in Spearfish Creek ranged from less than 3 per 100 ml to 370 per 100 ml and were generally higher after rainfall.
- Supporting data presented in Appendix A indicate that total coliform counts in the springs of the Spearfish Creek Alluvial Valley are higher when the monitoring was preceded (within 48 hours) by a rainfall event.
- Fecal coliform counts in the groundwater monitored outside of the Spearfish Creek Alluvial Valley indicated no contamination.

EPA concludes that the historic contamination of the Belle Fourche infiltration gallery and the Spearfish Creek Alluvial Valley in the vicinity of the infiltration gallery has been caused by storm events carrying coliform bacteria off the land surface via runoff. The concentrations of coliform vary with land use within the drainage, rainfall intensity, and frequency of rainfall. Typically a rainfall event will

FIGURE 4-2

WATER QUALITY MONITORING STATIONS

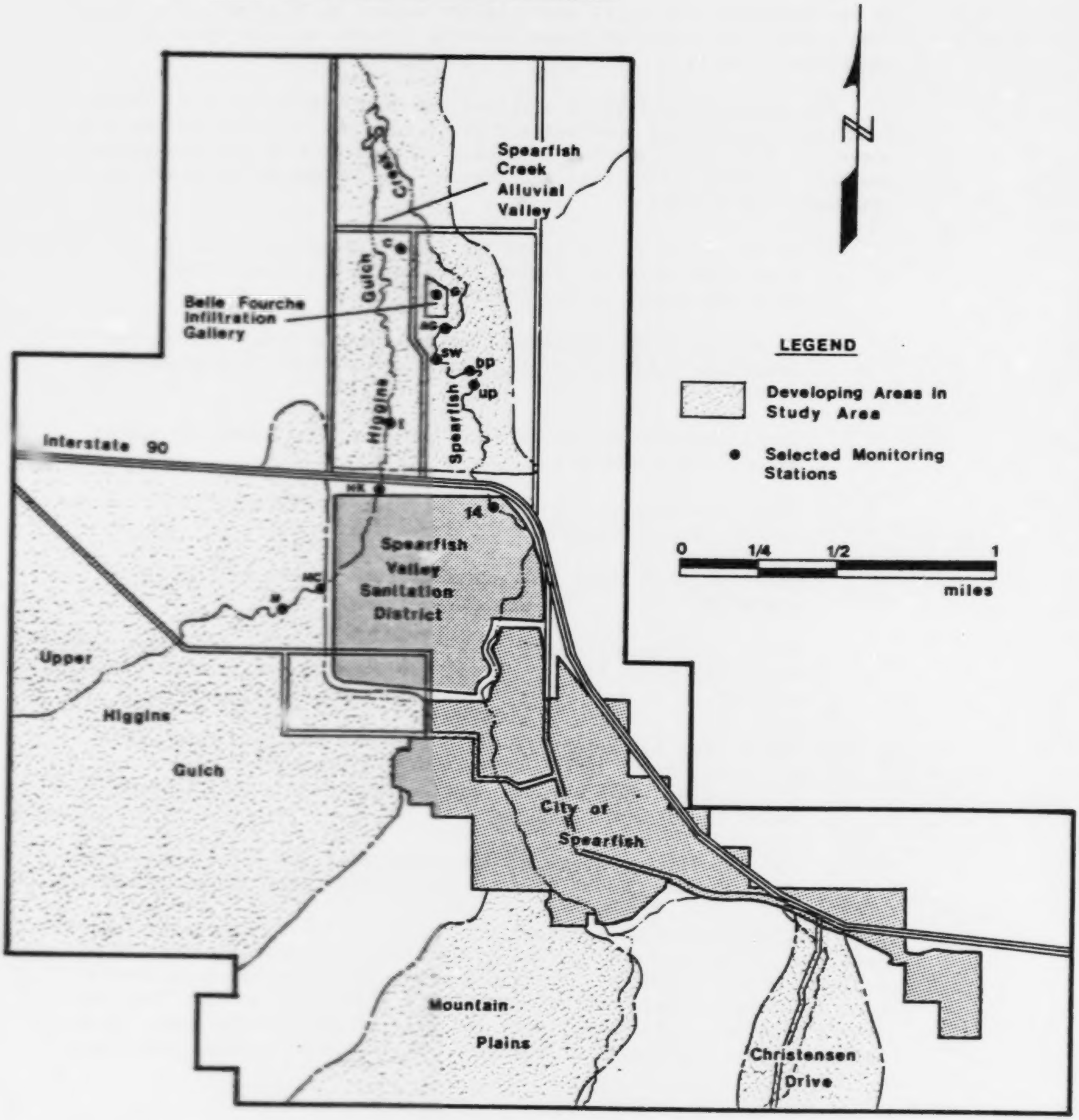

N
Spearfish Creek Alluvial Valley
Creek
c
Gulch
Belle Fourche Infiltration Gallery
G
SW
bp
up
I
Higgins
Spearfish
Interstate 90
HK
14
Spearfish Valley Sanitation District
HC
Upper Higgins Gulch
City of Spearfish
Mountain Plains
Christensen Drive
LEGEND
Developing Areas in Study Area
Selected Monitoring Stations
0
1/4
1/2
1
miles

TABLE 4-2
PRECIPITATION AND SELECTED WATER QUALITY DATA (JUNE 1978)

		GALLERY		CUNDY DRAIN (C)		HIGGINS GULCH								SPEARFISH CREEK				
						(H)		(HC)		(HX)		(I)		(14)	(UP)	(DP)	(SW)	(AG)
Day	Precipitation* (inches)	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Coliform #/100 ml
1	0.1																	
2																		
3																		
4																		
5																		
6																		
7																		
8	0.03																	
9																		
10																		
11	0.15																	
12		90	2															
13																		
14																		
15																		
16	TRACE	90	2	70	1	7000	13	5600	259									
17																		
18	0.62																	
19																		
20																		
21																		
22	0.07																	
23		18	0	25	0			1500^{e}	29									
24																		
25	0.20																	
26																		
27																		
28																		
29	TRACE	228	0	182	0	1400^{e}	5	4740	87	2700^{e}	118							
30	0.27																	
31																		

* Precipitation reported at Homestake Sawmill.
e Estimate.

TABLE 4-3
PRECIPITATION AND SELECTED WATER QUALITY DATA (JULY 1978)

		GALLERY		CUNDY DRAIN (C)		HIGGINS GULCH								SPEARFISH CREEK				
						(H)		(HC)		(HX)		(I)		(14)	(UP)	(DP)	(SW)	(AG)
Day	Precipitation* (inches)	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Coliform #/100 ml
1	1.00																	
2																		
3																		
4																		
5																		
6	0.20																	
7	0.35	55	2	20	0	380	30	1000	52	15,000	74							
8	0.30																	
9	0.19																	
10																		
11																		
12																		
13																		
14		146	1	38	0	340	34	950	276	500	56							
15																		
16	0.31																	
17																		
18																		
19																		
20																		
21	0.39	20	0	35	1	700	114	633	212	800	266							
22	1.20																	
23																		
24																		
25																		
26																		
27																		
28		38	1	18	0	560	46	633	8	667	96							
29	0.05																	
30	0.09																	
31	0.28																	

* Precipitation reported at Homestake Sawmill.
e Estimate.

TABLE 4-4
PRECIPITATION AND SELECTED WATER QUALITY DATA (AUGUST 1978)

Day	Precipitation* (inches)	GALLERY		CUNDY DRAIN (C)		HIGGINS GULCH								SPEARFISH CREEK				
						(H)		(HC)		(HX)		(I)		(14)	(UP)	(DP)	(SW)	(AC)
		Total Coliform #/100 ml	Fecal Coliform #/100 ml	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Coliform #/100 ml
1																		
2	0.09																	
3	0.20																	
4		26	0	14	0	1280	68	2000	18									
5																		
6																		
7																		
8																		
9																		
10																		
11	0.83	24	1	9	0	440	37	1000	275									
12																		
13																		
14	0.07																	
15	0.46																	
16																		
17	0.05																	
18		36	0	11	0	933	22	1700	80									
19																		
20																		
21																		
22																		
23																		
24																		
25																		
26																		
27																		
28	0.13																	
29																		
30	0.01																	
31																		

* Precipitation reported at Homestake Sawmill.
e Estimate.

TABLE 4-5
PRECIPITATION AND SELECTED WATER QUALITY DATA (SEPTEMBER 1978)

Day	Precipitation* (inches)	GALLERY		CUNDY DRAIN (C)		HIGGINS GULCH								SPEARFISH CREEK				
						(H)		(HC)		(HX)		(I)		(14)	(UP)	(DP)	(SW)	(AG)
		Total Coliform #/100 ml	Fecal Coliform #/100 ml	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Coliform #/100 ml
1																		
2																		
3																		
4																		
5		16	0		0								19	30	84	39	77	29
6																		
7																		
8																		
9																		
10																		
11	TRACE	12	0										16	88	370	90	96	165
12	0.05																	
13																		
14																		
15																		
16																		
17																		
18	0.12	330	0										24	102	44	62	92	70
19																		
20																		
21																		
22																		
23																		
24																		
25																		
26																		
27																		
28		160	2	30	2								13	3				34
29					0													
30	TRACE																	
31																		

* Precipitation reported at Homestake Sawmill.
c Estimate.

TABLE 4-6
PRECIPITATION AND SELECTED WATER QUALITY DATA (OCTOBER 1978)

		GALLERY		CUNDY DRAIN (C)		HIGGINS GULCH								SPEARFISH CREEK				
						(H)		(HC)		(HX)		(I)		(14)	(UP)	(DP)	(SW)	(AG)
Day	Precipitation* (inches)	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Total Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Coliform #/100 ml	Fecal Coliform #/100 ml
1	TRACE																	
2																		
3																		
4																		
5		1			0													
6																		
7																		
8																		
9																		
10																		
11	0.09																	
12																		
13																		
14																		
15																		
16																		
17		8	0		0								2	10	136	122	76	145
18	0.30																	
19																		
20																		
21																		
22	0.04																	
23																		
24																		
25	0.18																	
26	0.02																	
27																		
28																		
29																		
30		4	0		0								1	10	4	20	12	8
31																		

* Precipitation reported at Homestake Sawmill.
e Estimate.

initially flush the surface, delivering high concentrations to surface waters. The contaminated material will be generated by both developed and undeveloped land and is commonly referred to as nonpoint source contamination.

As the runoff moves down the drainage surface water elevations rise. Groundwater elevations in the gallery area will increase due to the increased water flowing in Spearfish Creek and Higgins Gulch. As the groundwater elevation rises the potential for short-circuiting of the septic tank absorption field in the West subdivision increases, thus potentially contributing to the coliform contamination that has been carried into the groundwater from the surface water. Because of the defined movement of the groundwater in the alluvial material the infiltration gallery became contaminated.

Field reconnossiance to identify the source of coliform contamination in the well at the mouth of Christensen Drive (Miller Ranch) indicated that the source of the well contamination is likely caused by development in the Christensen Drive alluvial valley upstream of this well. Septic tanks in this area are suspected as failing seasonally, and those in the shallow alluvium of the valley bottom are probably the contributing factors along with nonpoint sources in contamination of this well. The contamination of this shallow aquifer is attributable to the small confined characteristics of the alluvial valley which is underlain by impervious soils.

At this time no public health hazards or groundwater contamination are identified in the Mountain Plains area or Upper Higgins Gulch relative to septic tank systems. The Mountain Plains area does have a high potential risk of contaminating groundwater aquifers if conventional septic systems are used to dispose of wastewater as development density increases.

The approval and installation of the systems must be monitored on an individual site basis. The ultimate success or failure of on-site disposal systems will be determined by the Lawrence County Planning and Zoning Commission, and the Northern Hills Sanitarian.

In summary, the findings indicate that septic tank systems are a feasible means of sewage disposal in areas outside the City of Spearfish exept for the Spearfish Creek Alluvial Valley near the Belle Fourche infiltration gallery and the Christensen Drive Alluvial Valley. Because of the impermeable soils, the absorption fields in the Upper Higgins Gulch area should be constructed larger than the State code (See Appendix A) (7) requires and the systems may potentially function as evapotranspiration systems as opposed to the conventional leach field system.

FLOODPLAIN

Federal Executive Order 11988 (8) mandates that floodplain management be an integral part of all planning efforts that are Federally funded which will potentially encroach on a flood-prone area. For the Study Area, three documents are available which address the floodplain of Spearfish Creek and Higgins Gulch (9, 10, 11):

- Flood Insurance Study City of Spearfish South Dakota Lawrence County
- Land Capability Maps, Lawrence County
- Flood Hazard Boundary Map, Lawrence County, South Dakota

The Flood Insurance Study for the City of Spearfish covers all significant flooding sources affecting the City of Spearfish.

The Spearfish Land Capability Study, and the Lawrence County South Dakota Flood Hazard Boundary Map (Figure 4-3) present information on flood hazards in Lawrence County. However, neither of these documents are sufficient for floodplain management or land use decision making. The Spearfish Land Capability Study identifies flood hazards as they relate to the flooding potentials for soil mapping units defined by the Soil Conservation Service. This information does not account for drainage basin or other hydrologic features. The Flood Hazard Boundary Map (Figure 4-3) produced by the Flood Insurance Administration was developed using a discharge flow of 2500 cubic feet per second (cfs) in Spearfish Creek and 600 cfs in Higgins Gulch. The value in Spearfish Creek is below the 100 year flood flows calculated by the U.S. Army Corps and values used in Flood Insurance Study for the City of Spearfish. Presented in Table 4-7 is a comparison of flood discharge values for Spearfish Creek.

Review of the values presented in Table 4-7 indicates that the flood discharge value for Spearfish Creek beyond the Corporate limits of Spearfish is very conservative and actually represents a flow equivalent to a flood less than the 50-year flood event. Consequently, the current flood hazard boundary map should not be used in floodplain management planning. Proper floodplain management should restrict development within the 100-year floodplain which corresponds to a Spearfish Creek discharge of 7460 cfs.

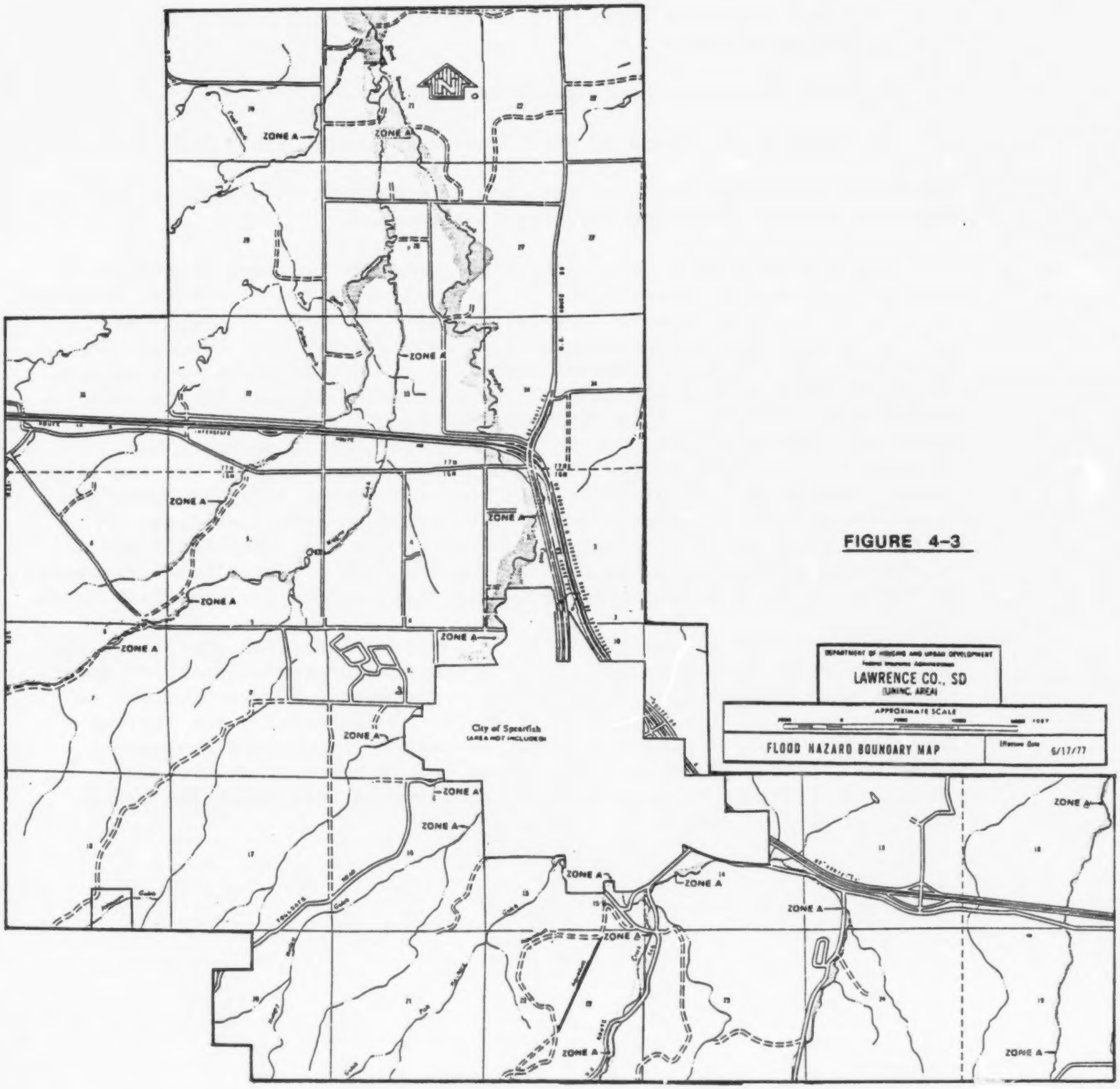

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration
LAWRENCE CO., SD
(UNINC. AREA)
APPROXIMATE SCALE
FLOOD HAZARD BOUNDARY MAP
Effective Date 6/17/77
City of Spearfish
(AREA NOT INCLUDED)
ZONE A

FIGURE 4-3

TABLE 4-7

DISCHARGE VALUES FOR SPEARFISH CREEK

Flooding Source and Location	Drainage Area (mi^2)	Peak Discharges (cfs)	
		50 year	100-year
Spearfish Cr. @ Conf. w/Hungry Hollow Gulch	168	4,450[1,2]	7,370[1,2]
Spearfish City Limits	172.2	4,510[1,2]	7,460[1,2]
Hungry Hollow Gulch @ Conf. w/Spearfish Cr.	2.7	650[2]	1,290[2]
Spearfish Cr	168		2,500[3]

1. U. S. Army Corps of Engineers, Personal communication, 3 December 1979
2. U. S. Department of Housing and Urban Development. Flood Insurance Study, City of Spearfish, South Dakota Lawrence County, Preliminary, March 29, 1979.
3. U. S. Department of Housing and Urban Development. Flood Hazard Boundary Map, June 1977.

FLOODPLAIN MANAGEMENT

The National Flood Insurance Program was established with a primary purpose of encouraging State and local governments to adopt floodplain management programs. Studies such as the Flood Insurance Study for the City of Spearfish, include sufficient detail of the flood boundary to develop floodplain management programs. However, the flood hazard boundary map of Lawrence County does not provide adequate or correct flood boundary information to aid in floodplain management. In view of this lack of detailed information, Lawrence County is not constrained in implementing floodplain management programs.

The Lawrence County Zoning Ordinance defines a Floodplain District for planning purposes. (12) Section 3.6 of the Zoning Ordinace states that, "the intent of the Floodplain District is to prevent loss of life, property damage, and protect public health through restriction of development in those areas subject to flood".

The permitted uses of property and buildings in the District are to be used only for the following purposes:

- Crop and pastureland and similar agricultural purposes.
- Open spaces not requiring a closed building.
- Fences.

- Storage yards for equipment and material properly anchored to prevent moving into bridges or other debris catching areas.
- Recreational and open space areas not requiring a closed building.
- Sanitary and storm sewer drains shall be equipped with safety valves capable of being closed to prevent backup of sewage and storm waters into building or structure.

The County Planning Commission can issue a Conditional Use Permit for developments in Floodplain Districts. These conditional uses include:

- Residences, providing they are located and constructed above the elevation of the floodway.*
- Agricultural buildings, such as barns and stables, provided they are located above the elevation of the floodway.*

Currently, adequate information is not available to define the elevation of the floodway along the major streams in Lawrence County outside the City of Spearfish. Therefore, no Conditional Use permits should be issued for development until the County develops criteria and procedures for floodplain/hazard identification.

The primary reason for the identification of flood hazard areas is to cause the human use of such areas to be compatible with hazards. There are many valuable uses which can be made of known hazard areas and also ways to minimize or eliminate the hazard. In the alluvial valley along Spearfish Creek, the floodplain coincides with a high groundwater table making septic tank disposal unsuitable. Prevention of residential development within the 100 year floodplain would eliminate the combined risks of possible loss of life and property or potential groundwater contamination. Guidance for techniques, methods and procedures for establishing floodplain restrictions in Lawrence County are presented in Chapter V. Refer to EPA's proposed decision in Chapter 1 which requests Lawrence County to implement acceptable floodplain regulations and requires a grant condition with the City of Spearfish and the Spearfish Valley Sanitarian District to prohibit development within the designated 100 year floodplain unless no practical alternative exists.

CULTURAL RESOURCES

On July 11 and 12, 1978 the South Dakota Archaeological Research Center conducted a linear pedestrian survey along the interceptor routes identified in the original Facilities Plan. (2) Associated with this work, a record search was also conducted.

The interceptor corridors surveyed had, for the most part, been radically disturbed previously and were also overgrown with heavy vegetation. These conditions resulted in a ground surface visibility of less than five percent overall.

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* Height above floodway is not specified but typically is one foot.

The record search revealed a number of historic sites in the vicinity of Spearfish which are on the National Register of Historic Places. These sites include:

- Episcopal Church of All Angels
- Frawley Historic Ranch
- Lown Home, William Ernest
- Spearfish Historic Commercial District
- Halloran-Mathews-Brady House
- Spearfish Fishery Center

The record search did not reveal any prehistoric sites in or near the project areas.

No prehistoric cultural material was located in the course of the survey. Since none of the National Register sites in the Spearfish vicinity are located within the proposed project areas they should not be affected by any of the proposed alternatives.

There is a special concern, however, with regard to the McGuigan farmstead. It is located in the SW¼, NW¼ of Section 4, Township 6 North, Range 2 East. The house has not been nominated to the Register at this time. The possibility exists, however, that it is eligible for nomination.

It is concluded that there are no known prehistoric or historic cultural resources which may be affected by the construction of the alternative facilities except the McGuigan farmstead. If the house or immediate area is to be affected, then steps will be taken to evaluate its eligibility to the National Register of Historic Places. Construction of the proposed interceptors however will not be on or near the McGuigan farmstead.

Cultural material, historic and prehistoric, may have gone undetected due to heavy vegetation or lack of surface indications. If any such material is discovered in the course of construction, work should cease in the affected area and the State Historical Preservation Officer should be notified.

ENVIRONMENTAL CONSEQUENCES
OF THE ALTERNATIVES

CHAPTER 5

CHAPTER 5

ENVIRONMENTAL CONSEQUENCES OF THE ALTERNATIVES

Environmental consequences of the proposed alternative systems must be viewed within the framework of the pertinent impacted features of the Study Area. It must be recognized that an environmental system is dynamic, with adjustments and compensations continually being applied to maintain the systems at a desired level. The management of water quality is a means of achieving environmental control which creates the need for adjustments throughout associated systems (i.e., land use, socio-economic, etc.). If the adjustments or tradeoffs among the water quality management alternatives are to be viewed openly, they must be displayed in such a manner that the key environmental consequences of every option are understandable to the various interests responsible for the decision-making process.

IMPACT ASSESSMENT CRITERIA

During the development of the updated Facilities Plan and this EIS four development areas and six wastewater management alternatives have been identified. To comparatively evaluate the consequences of these alternatives in the context of the critical environmental features of the Study Area it is necessary to define the impact assessment criteria.

Costs

The costs associated with the wastewater management alternatives are for capital investment, annual operation and maintenance (O & M), total annual costs, and monthly user costs. Costs have been updated from the original Facilities Plan.

Under the Clean Water Act, EPA can provide 75 percent of capital costs for wastewater plant upgrading, collection lines or sewer interceptors based on current grant eligibility guidelines. If the proposed system qualifies as an innovative or alternative system, the Federally funded share can be 85 percent. Sewer line sizes are based on the maximum population expected in 40 years in the service areas.

Reliability

Reliability of a particular alternative is assessed in terms of the various components ability to respond to external variables over the planning period. External variables include:

- temperature, and other climatic parameters
- process upsets, such as flooding
- failure of other subsystem components, such as soil saturation
- ability to provide acceptable wastewater and water quality management

Flexibility

Flexibility of the various alternatives is assessed relative to the ability of the system to accommodate possible future growth or expansion and associated wastewater management requirements.

Energy

Energy conservation is becoming a more stringent factor in selecting the most cost-effective alternative. The impact on energy consumption is assessed in terms of the relative energy demands of the various components of the given alternative including such items as transmission and pumping needs.

Water Quality

The existing water quality data base is reasonably extensive for the Study Area. However, data is not available to quantitatively determine the future water quality benefits of the alternatives. Further, the identified water quality problems are associated with nonpoint sources and the wastewater management alternatives do not treat this problem.

Each of the sub-areas has different water quality goals which EPA believes are pertinent for determing the proper wastewater management strategy. These various goals are:

- Spearfish Creek Alluvial Valley - protect surface and groundwater, insure protection of the Belle Fourche infiltration gallery.
- Upper Higgins Gulch - correct nonpoint source problems.
- Mountain Plains - protect the groundwater recharge area.
- Christensen Drive - protect surface and groundwater.

Nonpoint source management is addressed separately in this Chapter.

Cultural Resources

The potential impact to cultural resources, archaeological and historical, are a direct consequence of construction. Identification of cultural resources, their significance and mitigation measures necessary to protect and/or salvage them must be evaluated in Federally funded projects. Cultural resources are not currently of concern based on survey data.

Foreclosure of Future Options

The commitment of land and other resources resulting from the implementation of an alternative may foreclose the County's options for future land use management or wastewater management.

Funding

The alternatives must be considered in terms of the eligibility of the various component costs. This is not only as the costs relate to the EPA construction grants process but other agency participation and the local share. Alternatives for funding are presented separately in this Chapter.

System Manageability

System manageability is defined as the level or degree of effort and control with the City, County, and/or other regulatory agencies must exercise to sustain effective implementation and operation of any alternative. Manageability also includes the enforcement requirements of applicable regulations. Other factors include: staffing requirements, financial arrangements, and regulatory agreements.

ALTERNATIVE IMPACT ASSESSMENT

Spearfish Creek Alluvial Valley

No Action

Costs have not been developed for this alternative. The principal area that will be affected is the West Subdivision. The continued use of septic tank - leach field systems in this area will result in a low reliability of wastewater management. The soil absorption field will be susceptable to short circuiting during periods of high groundwater and potentially susceptable to flooding.

From the wastewater management perspective this option provides for good flexibility to accommodate future growth. However, when considered in the context of water quality management and development in a potential flood prone area this alternative has poor flexibility.

Direct energy costs associated with the alternative should be confined to periodic septic tank pumping and would consequently be low.

The protection and enhancement of water quality is not likely to be realized under this option. This developing area is identified as a probable contributor to the biological contamination of the Belle Fourche infiltration gallery. Consequently, the no action alternative will not provide corrective measures for this situation.

The no action alternative does not foreclose future options relative to water quality management. It does not provide protection or contribute to the accomplishment of water quality goals.

The no action alternative may foreclose future land use management objectives for flood prone areas by establishing a precedent of allowing development in such areas. Funding criteria are not applicable to the no action alternative.

Holding Tanks

Holding tanks offer a slightly higher reliability in the Spearfish Creek Alluvial Valley than the no action alternative. Holding tanks mitigate the problems identified with septic tank leach field. They are susceptible to the upset problems such as high groundwater conditions "floating" them out of the ground. Flooding problems are reduced significantly but seepage and infiltration into the tank is possible. A holding tank is not likely to be approved by the State Department of Natural Resources unless it is preceded by a septic tank or a chemical treatment unit. The original Facility Plan recommends that holding tanks have 5,000 gallon capacity. Assuming three people per dwelling generating 300 gallons per day the tanks would require pumping twice a month. This frequency of pumping will require a rigid maintenance schedule and variations in wastewater generation among homeowners further reduces the reliability of holding tanks.

The flexibility of this alternative relative to water quality management is very good. It is expected that residential growth could be accommodated through the use of holding tanks. However, like the no action alternative this option has poor flexibility when viewed in the context of water quality management coupled with land use management of flood prone areas.

Energy costs associated with this alternative are going to be high because of the energy requirements associated with operation and maintenance (bimonthly pumping requirements). Properly operated and maintained holding tanks will eliminate the domestic wastewater contributions to the contamination of the Belle Fourche infiltration gallery. Therefore, the water quality objectives of this area would be met.

Relative to future water quality management strategies for the area this option does not foreclose future options. This option may, however, foreclose future land use management objectives. Continued development in the Spearfish Creek Alluvial Valley potentially will establish a precedent of endorsing development in flood prone areas.

The manageability of this alternative is low. To insure successful water quality management strict operation and maintenance must be adhered to. Land use management of the Spearfish Creek Alluvial Valley is also poor under this alternative.

Funding assistance for this alternative is not available from Federal and State agencies. This is because the systems as proposed do not satisfy State septic tank regulations (7). Funding by local agencies is not likely to be available for the same reason. Therefore, this alternative is dropped from further consideration for all development areas.

Evapotranspiration

Evapotranspiration systems provide a low to moderate level of reliability relative to wastewater management. The original Facility Plan states that these systems will be susceptible to disruption due to winter temperatures during which pumping will be required. It is estimated that a 5,000 gallon septic tank will require pumping approximately twice a month. This feature coupled with potential problems associated with high groundwater and flooding reduces the overall reliability of the systems.

This alternative provides good flexibility to accommodate future growth in terms of wastewater management requirements. The energy costs will be higher than those associated with conventional septic tank systems.

Evapotranspiration systems with properly sealed beds will achieve the water quality goals for the Spearfish Creek Alluvial Valley area.

Future options for this area relative to water quality management should not be constrained. However, options for comprehensive land use management and planning may be foreclosed. The use of on-site systems potentially will encourage unconstrained development.

Federal and State funding is available for evapotranspiration systems. Certain criteria must be met in order for units to be eligible. Systems in flood prone areas may not be eligible for certain types of funding.

System manageability is good for water quality management but poor for land use management. Current limited enforcement of septic tanks systems could result in improperly installed systems which would result in jeopardizing water quality.

Gravity Collection/Pressure Interceptor

The reliability of this alternative is very high as a means of collecting and conveying wastewater from this area to the Cities' wastewater treatment facility. The most vulnerable component of this system is the pump stations. Proper seal of the system will eliminate infiltration/inflow problems present with the high groundwater level.

System flexibility is expected to be fair. The system will be sized to accommodate ultimate development based on current plats. However, future developments may not be able to use the system due to capacity constraints. The interceptor line could be used as a growth management tool.

Energy requirements of this system will be moderate. Primary energy demand will be the lift station.

This alternative achieves water quality goals of the area. The collection/interceptor would convey wastewater out of the area. This feature is very desirable to insure protection of groundwater, surface water and protection of the Belle Fourche water supply.

This alternative does foreclose future wastewater management alternatives for the developments in the area. They will be committed to the system for the design life. This alternative also can foreclose certain land use options but can service as a growth management tool.

Manageability of this system is very good since a sewering agency will be responsible for the system. There is a higher probability that residents will connect into the system when financial incentives of a sewering agency are necessary. (i.e. homes within 200 feet will tie into the system when a sewering agency has enforcement powers).

Pressure Effluent System

This system has a moderate level of reliability. Reliability of this alternative is decreased because of maintenance requirements associated with the septic tank effluent pumps and the package plant. The system is not expected to be highly susceptable to upsets. However, the package plant would be vulnerable to floods. This can be mitigated at additional cost.

The flexibility of this system to accommodate future wastewater flows and strategies is fair. The hydraulic capacity of the package plant and interceptor will determine ability to handle flows. This system commits the area to this system during the life of the facilities.

Energy consumption will be moderate to high. In addition, to energy requirements associated with the package plant, and pumps for effluent, septic tank pumping will consume additional energy.

Water quality goals of the Spearfish Creek Alluvial Valley can be accomplished. However, disruption of operation of the package plant slightly reduces the reliability of continued achievement of water quality protection.

Options for future water quality management are foreclosed until the life of the system components are met. Similiarly, land use option could be foreclosed if the hydraulic capacity of the system is used to control development.

Funding is available from Federal and State agencies. These options are discussed separately in this Chapter.

System manageability is moderately good. Some form of sewering agency will be required for operation and maintenance of the system. The least manageable component of the system is associated with septic tank maintenance. If septic tank maintenance is handled by the serving agency then good manageability is expected.

Gravity Collection/Package Plant

This system has a high degree of reliability for collecting and conveying wastewater. The package plant is the primary component that decreases the overall reliability. This component is the most vulnerable to system upsets such as flooding.

The flexibility of this system is expected to be fair. Flexibility constraints are associated with hydraulic capacity of lines.

Energy consumption will be moderate and consist of operation and maintenance requirements of the pump station.

Water quality objectives for the Spearfish Creek Alluvial Valley are achieved with this alternative. This system will protect ground and surface water, and the Belle Fouche infiltration gallery.

Future options for water quality management strategies will be foreclosed for the life of the systems.

Hydraulic capacity of the system can function as a growth management tool. This may result in foreclosing certain land use management options.

System manageability of this alternative is very good. The responsiblity of the system will be placed with an identified sewering agency. A single management agency with financial responsibilities generally prove very effective in operating and maintaining sewer systems.

The alternative assessement for the Spearfish Creek Alluvial Valley is summarized in Table 5-1.

Upper Higgins Gulch

No Action

The reliability of the no action alternative for the subdivisions in the Higgins Gulch area is very good. It has been demonstrated that most of the septic tank systems are functioning properly when installed according to State regulations. Reliability is decreased due to undersized leach fields and tight soils. This has resulted in the identification of seasonal failures. Because of the scattered nature of development in this area particular subdivisons will have to consider specific site conditions (i. e. Westfield Subdivision will require design features that consider perched water table conditions). Septic tank systems have not proven vulnerable to climatic upsets. However, overall reliability depends on the owners satisfying requirements for periodic pumping.

Good flexibility is achieved. Future growth in the area is constrained only relative to minimum lot size requirements as defined in the State regulations.

Energy consumption is low for this alternative. Energy demands will be confined to the periodic pumping requirements during the life of the individual system.

Studies and analysis conducted as part of the EIS indicate water quality problems for the entire Study Area are associated with nonpoint sources. The continued use of septic tanks in Upper Higgins Gulch will achieve water quality goals and protect surface and groundwater.

TABLE 5-1

IMPACT EVALUATION MATRIX
SPEARFISH CREEK ALLUVIAL VALLEY

ALTERNATIVE	EVALUATION CRITERIA RELIABILITY	FLEXIBILITY	ENERGY	WATER QUALITY
No Action	Low-subject to treatment disruption from high ground water and flooding.	Accommodates future growth, but encourages development in flood hazard area. Lack of controls aid flexibility.	Low	Future options open for wastewater management. Continued flood area development may foreclose future land use options.
Evapotranspiration	Low to moderate - subject to disruption. Moderate to high O & M requirement.	Very good - accommodates future growth. Lack of control aids flexibility.	Moderate	Achieves water quality goals of area if installation is correct (i.e. sealed leach field).
Gravity Collection/ Pressure Interceptor	Very high - removes wastewater from area. Pumps vulnerable to disruption.	Fair - hydraulic capacity may limit growth, if land use and septic tank regs. enforced.	Low to moderate	Achieves water quality goals of area.
Pressure Effluent/ Package Plant	Moderate - minimal potential for disruption. Septic tank and pump maintenance high. Package plant subject to disruption.	Fair - same as above	Moderate to high	Achieves water quality goals of area.
Gravity Collection/ Package Plant	High-removes wastewater from area	Fair to moderate - hydraulic capacity will limit growth within 200 feet of system	Low	Achieves wastewater management goals but not nonpoint management goals of area.

TABLE 5-1 (CONT'D)

EVALUATION CRITERIA

ALTERNATIVE	FUTURE OPTIONS	SYSTEM MANAGEABILITY	COSTS[1] ($)			
			TOTAL CAPITAL	ANNUAL O&M	MONTHLY USER	EQUIVALENT COST
No Action	Future options open for wastewater management. Continued flood area development may foreclose future land use options.	Poor - no control of land use or wastewater in an area contributing to problems	3,000	25.00	25.92	311.00
Evapo-transpiration	Same as above	Fair - potential for improper installation threatens goals of the area.	36,000[2] 174,000[3]	4,020[2] 19,430[3]	62.98[2] 103.49[3]	7,452.00[2] 36,016.00[3]
Gravity Collection/ Pressure Interceptor	Foreclose future wastewater management options and use management options may be foreclosed.	Very good - would require sewering agency. Coordination with City may be required.	109,870	5,000	30.67	14,149.00
Pressure Effluent/ Package Plant	Same as above.	Fair to good - would require sewering agency. Requires O & M of septic tanks and package plant Coordination with City may be required.	71,380	9,000	45.41	15,804
Gravity Collection/ Package Plant	Same as above	Good - would require sewering agency. O&M mainly limited to package plant. Coordination with City may be required.	90,010	8,000	40.29	15,972.00

1. Costs developed by Scott Engineers, Facilities Plan Update.
2. Homes built before December 1977 - 85 percent Federal Fund.
3. Homes built after December 1977 - 0 percent Federal Fund.
4. Costs for upgrading failing and suspected failing systems are presented in Table 5-5.

The no action alternative does not foreclose any future option relative to wastewater management or land use. Constraints on minimum lot sizes is not viewed as a constraint for development.

Based on current management practices, the overall system manageability of this alternative is low. This is a consequence of the lack of enforcement of State septic tank regulations at the County level.

Evapotranspiration

Reliability of evapotranspiration systems in the Higgins Gulch area is moderate to good. Several of the suspected seasonal failures identified using aereal imagery are functioning as evapotranspiration systems. This is because the leach fields are too small for the tight soils which reduce percolation. The original Facility Plan indicates that these systems will experience disruption due to harsh winter conditions and will require pumping four months of the winter. If these systems are constructed with a mound system climatological upsets will be more probable, however, it is expected that these systems can function properly in the Upper Higgins Gulch. Winter maintenance requirements reduce the reliability of these systems.

This alternative for Upper Higgins Gulch provides a good level of flexibility to accommodate future growth and wastewater management.

Energy requirements associated with this alternative will be high if winter pumping is required. Energy requirements will be higher than those associated with conventional septic tanks.

Evapotranspiration systems will contribute to achieving wastewater management goals of the Upper Higgins Gulch area.

This alternative is not expected to foreclose future options for wastewater management or land use management in this area. However, this will be predicated on the enforcement of State regulations for onsite systems at the County level.

Funding assistance for evapotranspiration is available. Certain criteria must be met in order for units to be eligible.

System manageability is good for wastewater management providing State regulations are enforced. As a land use management tool this alternative has poor manageability.

Gravity Collection/Interceptor

The reliability of this system is very high as a means of collecting and conveying wastewater from this area to the Cities wastewater treatment facilities. Reliability is enhanced by gravity conveyance of wastewater.

System flexibility is fair to moderate. The system would be sized to accommodate growth for the planning period, however, hydraulic capacities may limit development within 200 feet of line (State requirement for mandatory connection to system).

Energy requirements for this alternative will be low. No major energy use components are associated with this system.

The alternative achieves wastewater management goals of this area.

Collection and interceptor lines foreclose future options for wastewater management during the design life of the system. The area will be committed to the system and may experience land use/development constraints due to hydraulic limits.

Manageability of this system is very good since a sewering agency would be responsible for operation and maintenance of the system.

Presented in Table 5-2 is a summary of the impacts for alternatives considered in the Upper Higgins Gulch sub-area.

Mountain Plains

No Action

The continued use of septic tank-leach field systems in Mountain Plains will result in a low to moderate reliability of wastewater/water quality management. Use of these systems is extremely site specific and reliability is contingent upon the presence of acceptable soils. The fractured bedrock, shallow soil, and groundwater recharge areas in Mountain Plains reduce reliability of these systems.

These systems provide low to moderate flexibility to accommodate future growth because of site specific conditions. The site conditions can limit the future growth of the area provided State regulations are enforced.

Direct energy costs will be low to moderate due to costs/consumption associated with transport and pumping.

Water quality goals and wastewater management objects will be jeopardized under the no action alternative. The proliferation of septic tanks and conventional leach fields in this area threaten the groundwater quality.

The no action alternative does not foreclose future options relative to wastewater management. However, should these systems result in groundwater contamination they could foreclose land use/development options.

Funding from EPA is not likely to be available for this alternative in the Mountain Plains area due to the sensitivity of the area.

System manageability is currently poor and has the potential of continuing. This lack of system manageability was recently demonstrated

TABLE 5-2

IMPACT EVALUATION MATRIX
UPPER HIGGINS GULCH

	EVALUATION CRITERIA			
ALTERNATIVE	RELIABILITY	FLEXIBILITY	ENERGY	WATER QUALITY
No Action	Very high - care must be taken to insure proper design and installation conform to state regs. Low potential for on-site system disruption.	Very good - accomodates future growth. Lack of land use controls aids flexibility.	Low	Achieves water quality goals for wastewater management but does manage nonpoint source problems of area.
Evapotranspiration	Moderate to high - must be designed & installed to State regs. Subject to disruption during winter. Moderate to high O & M requirements.	Same as above.	Moderate	Achieves wastewater management goals but not nonpoint management goals at area.
Gravity Collection/ Interceptor	Very high-removes wastewater from area.	Fair to Moderate-hydraulic capacity will limit growth within 200' of system.	Low	Achieves wastewater management goals but not nonpoint management goals of area.

TABLE 5-2 (CONT'D)

EVALUATION CRITERIA

			COSTS[1] ($)			
ALTERNATIVE	FUTURE OPTIONS	SYSTEM MANAGEABILITY	TOTAL CAPITAL[4]	ANNUAL O&M	MONTHLY USER	EQUIVALENT COST
No Action	Future options for wastewater and land use management open.	Low-Current lack of enforcement of regulations does not insure proper design & installation.	3,000.00	25.00	25.92	311.00
Evapo-transpiration	Same as above.	Same as No Action for Upper Higgins Gulch	324,000.00[2] 576,000.00[3]	36,180.00[2] 64,320.00[3]	62.98[2] 103.49[3]	67,064.00[2] 119,224.00[3]
Gravity Collection/ Interceptor	Forecloses future wastewater management options within 200' of system. Land use may also be foreclosed.	Very good - requires sewering agency. Coordination with City may be required	389,700.00	6,000.00	16.88	18,541.00[5] 19,908.00[5]

1. Costs developed by Scott Engineers, Facilities Plan Update.
2. Homes built before December 1977 - 85 percent Federal Fund.
3. Homes built after December 1977 - 0 percent Federal Fund.
4. Costs for upgrading failing and suspected failing systems are presented in Table 5-5.
5. Interceptor only.

to EPA. A recently constructed home in Mountain Plains was permitted by the Black Hills Sanitarian to install a Pure-Cycle on-site sewage treatment system. The system was installed so that the effluent discharged down a dry drainage way. No consideration was given to the requirements for a National Pollution Discharge Elimination System (NPDES) permit, water quality, or public health. EPA, upon inspection of the system, requested that an NPDES permit be requested. The request was subsequently denied and the discharge eliminated by constructing a mounded leach field.

Evapotranspiration

Evapotranspiration systems can achieve a high degree of reliability in achieving water quality goals and the protection of the recharge area if raised, sealed beds are incorporated into the system. The four month, winter pumping requirement reduces the reliability of these systems.

Flexibility of these systems is considered to be very good relative to future growth and wastewater management.

Winter pumping requirements will increase the energy requirements of this alternative. Energy consumption will be higher than conventional septic tanks.

Water quality goals and wastewater management of the Mountain Plains area can be accomplished with this alternative. Of the on-site alternatives evapotranspiration systems provide the greatest insurance for protecting the recharge area.

Future options for wastewater management and land use management will not be foreclosed with this alternative.

Federal and State funding is available for evapotranspiration systems. Certain criteria must be met in order for units to be eligible. In the Mountain Plains area it will be necessary to insure that the aquifer recharged in this area is protected. This can be accomplished with proper design, construction, and operation.

System manageability can be good. Current limited enforcement of State regulations for on-site systems could result in improperly installed systems which could jeopardize water quality.

Gravity Collection/Interceptor

Reliability of this alternative is very high as a means of collecting and conveying wastewater from Mountain Plains to the Cities wastewater facilities. Gravity conveyance of the wastewater enhances the reliability of this alternative.

The flexibility of this alternative is fair to moderate relative to wastewater management. The hydraulic capacity of the system would accommodate growth during the planning period. However, the proposed systems would only serve Mountain Plains No. 1. The potential exists that capacities could not be designed into the system for Mountain Plains No. 2 without over designing the system. This feature reduced the overall flexibility of the system to meet future growth requirements for wastewater management.

Energy requirements for this alternative would be low. No major energy using components are associated with this system.

Wastewater management and water quality goals are achieved with this alternative.

This alternative will foreclose future options for wastewater management in Mountain Plains No. 1 and may constrain options in Mountain Plains No. 2 during the design life of the system. The area will be committed to the system and may experience land use/development constraints due to hydraulic limits.

System manageability of this alternative is very good. A sewering agency will be required and would have operation, maintenance, and enforcement responsibilities for the system. Presented in Table 5-3 is a summary of the assessment for Mountain Plains.

Christensen Drive

No Action

Reliability in terms of wastewater management is low for the no action alternative. It has been documented that groundwater contamination in the area has occurred and is a consequence of septic tank systems in the alluvial valley. Above the alluvial valley (Chris' Campground) it is suspected seasonal failures are occurring due to overloading the leach field, improper construction, and inadequate soils. Further, septic tank systems in the alluvial valley are subject to having their leach fields short circuited during periods of high runoff and flooding.

Flexibility of this alternative to accommodate future wastewater management strategies is good. However, land use and development can not be accommodated since septic systems with conventional leach fields should not be allowed in new development in the area.

Direct energy costs will be low and primarily associated with maintenance/pumping requirements.

This alternative will not accomplish water quality or wastewater management goals of the Christensen Drive area. These systems in the area contribute to the contamination of groundwater. No action will provide no correction of this situation.

Under this alternative future options for water quality management are not foreclosed. However, future land use and development options may be constrained. Without the correction of water quality problems development

TABLE 5-3

IMPACT EVALUATION MATRIX
MOUNTAIN PLAINS

ALTERNATIVE	EVALUATION CRITERIA			
	RELIABILITY	FLEXIBILITY	ENERGY	WATER QUALITY
No Action	Low to moderate - site specific conditions will determine vulnerability to upsetting treatment.	Low to moderate - site conditions will dictate ability to accomodate future growth. Current lack of controls aids flexibility.	Low to moderate	May not achieve water quality goals of area. Proliferation of development and lack of installation controls jeopardizes area goals.
Evapotranspiration	Moderate to high - must be designed and installed to State regs. Subject to disruption during winter. Moderate to high O & M requirements	Same as above	Moderate	Achieves water quality goals of area. Systems must be installed properly.
Gravity Collection/ Interceptor	Very high - removes wastewater from area.	Fair to moderate - hydraulic capacity may not be sufficient to accomodate future development.	Low	Achieves water quality goals of area if future development accomodated.

TABLE 5-3 (CONT'D)

EVALUATION CRITERIA

ALTERNATIVE	FUTURE OPTIONS	SYSTEM MANAGEABILITY	COSTS[1] ($)			
			TOTAL CAPITAL[4]	ANNUAL O&M	MONTHLY USER	EQUIVALENT COST
No Action	Future wastewater management options open. Land use management may be foreclosed if state regs. not met.	Poor-Current lack of enforcement of regulations would likely continue.	3,000	25.00	25.92	311.00
Evapotranspiration	Same as above.	Low-Current lack of enforcement of regulations does not insure proper design and installation. Winter O & M must be insured.	12,000[2] 312,000[3]	1,340.00[2] 34,840.00[3]	63.00[2] 103.49[3]	2,484.00[2] 64,580.00[3]
Gravity Collection/ Interceptor	Forecloses future wastewater management options for service area. Land use option may be foreclosed.	Very good - requires sewering agency. Coordination with City may be required.	319,750	2,500.00	48.34	2,423.00[5] 26,701.00[5]

1. Costs developed by Scott Engineers, Facility Plan Update.
2. Homes built before December 1977 - 85 percent Federal Fund.
3. Homes built after December 1977 - 0 percent Federal Fund.
4. Costs for upgrading failing and suspected failing systems are presented in Table 5-5.
5. Interceptor only.

may be stopped since the no action alternative would perpetuate septic tank systems in the area.

Minimal system management is achievable with this alternative. Current limited controls/enforcement of State regulations could result in septic tanks being installed improperly in the area further aggrevating water quality problems. Furthermore, land use controls may perpetuate development if wastewater management controls are not enforced.

Evapotranspiration

A low to moderate level of reliability is expected for wastewater management under this alternative. Based on the assumption that winter pumping would be required, reliability is reduced. The current lack of enforcement related to design and installation of the systems further makes the reliability questionable. In the alluvial valley disruption is a potential problem due to flooding even if a raised bed is incorporated.

The alternative does provide good flexibility to meet wastewater management of future development. However, as a land use management tool the flexibility to direct and control future growth is poor.

Moderately high energy requirements are associated with this alternative. Identified winter pumping is the primary cause of higher energy costs.

If these systems are properly installed and maintained, the water quality objectives for Christensen Drive can be achieved.

Future wastewater management options should not be constrained by implementing this alternative. Based on current trends on-site systems may result in unconstrained development. Such a condition could foreclose future development options.

Gravity Collection/Interceptor

This alternative has a very high degree of reliability as a means of collecting and conveying wastewater in the Christensen Drive area. Reliability is reduced due to the seasonal variations anticipated due to use of the two campgrounds. Reliability is enhanced because wastewater will be conveyed by gravity.

Flexibility is fair to moderate. Hydraulic capacities may constrain future growth, particularly if on-site systems are not encouraged. Because the system would be designed for only future development during the planning period unanticipated development may not be accommodated.

Energy requirements associated with operation and maintenance would be low. No energy using components are expected to be required in this system.

Wastewater management and water quality goals will be accomplished. Wastewater will be removed from the area.

Future options for wastewater management will be foreclosed in the area during the design life. The area will be committed to the system as the wastewater management strategy. Hydraulic limits of the system may foreclose future land use options.

The alternative provides a high level of system manageability. A sewering agency will be required which will be responsible for operation, maintenance, and enforcement elements of the system.

A summary of the impacts identified for the Christensen Drive alternatives is presented in Table 5-4.

COSTS

Cost estimates for the alternatives have been updated as part of the update of the Facility Plan. The costs are presented in Appendix D. The no action alternative for all sub-areas does not have any developed costs per se. However, the correction of identified and suspected seasonal septic tank failures costs have been developed. Since these improvements do not constitute a defined alternative it is assumed that where identified water quality problems are not associated with septic tank systems, the no action alternative would include these correctional costs which are presented in Table 5-5.

TABLE 5-4

IMPACT EVALUATION MATRIX
CHRISTENSEN DRIVE

ALTERNATIVE	EVALUATION CRITERIA			
	RELIABILITY	FLEXIBILITY	ENERGY	WATER QUALITY
No Action	Low-current treatment is being disrupted due to high ground water and soil/slope conditions,	Low to moderate - Lack of enforcement of State regs. would aid flexibility to accomodate future growth	Low	Does not achieve water quality goals of area.
Evapotranspiration	Low to moderate - subject to disruption. Moderate to high O & M. Must be designed and installed to State regs.	Same as above.	Moderate	Achieve water quality goals of area. Must be installed properly.
Gravity Collection/ Interceptor	Very high - removes wastewater from area.	Fair to moderate - hydraulic capacity may not be sufficient to accomodate future growth.	Low	Achieved water quality goals of area.

TABLE 5-4 (CONT'D)

EVALUATION CRITERIA

ALTERNATIVE	FUTURE OPTIONS	SYSTEM MANAGEABILITY	COSTS[1] ($) TOTAL CAPITAL[3]	ANNUAL O&M	MONTHLY USER	EQUIVALENT COST
No Action	Wastewater management option open. Land use/development options may be foreclosed.	Poor - Current lack of enforcement of regulations would likely continue.	3,000	25.02	25.92	311.00
Evapotranspiration	Same as above	Low - Current lack of enforcement of regulations does not insure proper design and installation. Winter O & M not manageable.	162,000[2]	18,090.00[2]	62.98[2]	33,532.00[2]
Gravity Collection/ Interceptor	Forecloses future wastewater management options for service area. Land use management may be foreclosed.	Very good - requires sewering agency. Coordination with City may be required.	89,390 11,805 (Kris' Campground)	1,000.00 500.00 (Mountain View)	27 res. 6.85 110.73 32.70	8,443 (Interceptor Collection)

1. Costs developed by Scott Engineers, Facilities Plan Update.
2. Homes built before December 1977 - 85 percent Federal Fund.
3. Costs for upgrading failing and suspected failing systems are presented in Table 5-5.

TABLE 5-5

FAILING OR SUSPECTED SEASONAL FAILURES OF LEACH FIELDS THROUGHOUT THE STUDY AREA[1]

Present Size, Theoretical Proposed Size, Estimated Cost

(VERIFIED SEPTIC FAILURES)

① Palmer Pearson	No Leach Field	Now has one built
② Robert Oien	Size of Leach Field Maximum Possible - 280 ft^2 Probably less, 200 to 250 ft^2	No Perc. data is available for this immediate area. Soils in area indicated to be 30-100 min/in. Will use 30 min/in. Area required about 250 ft^2/bedroom

2 bdrms x 250 ft^2 = 500 ft^2
Leach field probably needs additional 250 ft^2 maximum or about 80 L.F.
80 L.F. x $6.00/L.F. = $480.00

Price Mound System
500 ft^2 ÷ 3 = 167 L.F.
No Pump Should Be Needed
Const. Cost = $2,000.00

(SUSPECTED SEASONAL FAILURES)

1. Robert Klumb	Size of Leach Field About 100 L.F. of line 300 ft^2 leach field	Same perc. data information as Robert Oien

3 bdrms x 250 ft^2 = 750 ft^2
Leach field probably needs additional 450 ft^2 maximum or about 150 L.F.
150 L.F. x $6.00/L.F. = $900.00

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1. SOURCE: Scott Engineers

TABLE 5-5 (continued)

(SUSPECTED SEASONAL FAILURES)

2.	Jack Delaney	Size of Leach Field About 120' long, 20' wide Looks to have 3 lines About 720 ft^2 Leach Field	Same perc. data information as Robert Oien
		3 bdrms x 250 ft^2 = 750 ft^2 Leach Field is adequate, may need 10 L.F. addition 10 L.F. x $6.00/L.F. = $60.00	
3.	Bob Koski	Not able to determine the exact leach field, believed to be about 250 ft^2	Same perc. data information as Robert Oien
		2 bdrms x 250 ft^2 = 500 ft^2 Leach field probably needs additional 250 ft^2 or about 80 L.F. 80 L.F. x $6.00/L.F. = $480.00	
4.	Bob Hanson	About 118 L.F. of line 354 ft^2 Leach Field	Many leach fields in area have 540 ft^2. Perc. test in lot nearby showed 5 min/in. which would be 125 ft^2/bdrm. Soil charts show area should be 30-100 min/in. Will use 15 min/in. or 190 ft^2/bdrm
		3 bdrms x 190 ft^2 = 570 ft^2 Leach field probably needs additional 210 ft^2 or about 70 L.F. 70 L.F. x $6.00/L.F. = $420.00	
5.	Melvin Seymour	About 150 L.F. of line 450 ft^2 leach field	Same Perc. data information as Bob Hanson
		4 bdrms x 190 ft^2 = 760 ft^2 Leach field probably needs additional 310 ft^2 or about 103 L.F. 103 L.F. x $6.00/L.F. = $618.00	

TABLE 5-5 (continued)

(SUSPECTED SEASONAL FAILURES)

6.	Rick Price	Size of Leach Field About 103 L.F. of line 309 ft^2 leach field	Same perc. data information as Bob Hanson
		3 bdrms x 190 ft^2 = 570 ft^2 Leach field probably needs additional 260 ft^2 or about 87 L.F. 87 L.F. x $6.00/L.F. = $522.00	
7.	Curtis McKee	About 110 L.F. of line 330 ft^2 leach field	Same perc. data information as Bob Hanson
		3 bdrms x 190 ft^2 = 570 ft^2 Leach field probably needs additional 240 ft^2 or about 80 L.F. 80 L.F. x $6.00/L.F. = $480.00	
8.	Fred Fox	110 L.F. (Could be one or two lines) 330 ft^2 to 660 ft^2 leach field	Leach fields in area have 600 ft^2 Data available for this general area show perc rates to be 15 to 30 min/in. Soil charts show 30-100 min/in., will use 30 min/in. or 250 ft^2/bdrm.
		3 bdrms x 250 ft^2 = 750 ft^2 Under worst conditions leach field might need 420 ft^2 extension or 140 L.F. 140 L.F. x $6.00 = $840.00	
9.	Stan Allen	600 ft^2 leach field	Same perc. data information as Fred Fox
		3 bdrms x 250 ft^2 = 750 ft^2 Leach field probably needs 150 ft^2 additional or 50 L.F. 50 L.F. x $6.00 = $300.00	

TABLE 5-5 (Continued)

(SUSPECTED SEASONAL FAILURES)

10	Tom Freece	Originally undersized Leach field has been extended, 600 ft^2	Same perc. data information as Fred Fox

3 bdrms x 250 ft^2 = 750 ft^2
Leach field might need 150 ft^2 additional or 50 L.F.
50 L.F. x \$6.00 = \$300.00

12	John Jeffery	106 L.F. of line 318 ft^2 leach field	No perc. data is available for this immediate area. Soils charts show perc. rates to be 30-100 min/in. Owner indicated there was some gravel in soil and perc. rate was definitely not that slow. Will use 30 min/in or 250 ft^2/bdrm.

2 bdrms x 250 ft^2 = 500 ft^2
Leach field may need 180 ft^2 addition or about 60 L.F.
60 L.F. x \$6.00 = \$360.00

11	Chris' Campground	140 total sites 20 complete hookups 1 bath house - 4 showers - 7 stools 1 bath house - 4 showers - 7 stools 1 laundry

#1 Leach Field
60 sites, 1 bath house
60 sites x 2 persons/site x 35 gal/person = 4,200 gal/day

Length of field approx. 660 L.F. or about 1,980 ft^2
Will use 30 min/in. perc. rate, same as Jeffery
with perc. rate 30 min/in. = 0.9 gal/ft^2/day
4,200 gals $\div$ 0.9 gal/ft^2 = 4,667 ft^2 required

This drain field probably needs about 2,687 ft^2 more or about 895 L.F.
895 L.F. x \$4.00/L.F. = \$3,580.00

TABLE 5-5 (Continued)

(SUSPECTED SEASONAL FAILURES)

11. Chris' Campground (Continued)

#2 Leach Field	60 sites, 1 bath house = 4,200 gal/day Length of field approx. 1,058 L.F. or about 3,174 ft^2 + 1 dry well (63 ft^2) (ave. 4' dia., 5' deep) Same perc. rate data. Need about 2,625 ft^2 This leach field probably needs about 1,430 ft^2 or about 477 L.F. 477 L.F. x \$4.00 = \$1,908.00
#3 Leach Field	20 sites, complete hookups 20 sites x 2 persons/site x 50 gal/person = 2,000 gal/day Length of field approx. 130 L.F. or about 390 ft^2 + 1 dry well (63 ft^2) Same perc. rate data. 2,000 gal/day ÷ 0.9 gal/ft^2 = 2,222 ft^2 Need about 1,769 ft^2 additional drain field or about 590 L.F. 590 L.F. x \$4.00 = \$2,360.00
#4 Leach Field	House & Two trailers - 7 bedrooms Same perc. rate data as John Jeffery 250 ft^2/bdrm Length of field approx. 260 L.F. or about 780 ft^2 + 3 dry wells (63 ft^2) ave. 4' dia., 5' deep) 7 bdrms x 250 ft^2 = 1,750 ft^2 Increase leach field about 781 ft^2 or about 260 L.F. 260 L.F. x \$4.00 = \$1,040.00

TABLE 5-5 (continued)

(SUSPECTED SEASONAL FAILURES)

11. Chris' Campground (Continued)

#5 Leach Field 6 trailers - 12 bdrms

Same perc. rate data as John Jeffery

Length of field approx. 250 L.F. or about 750 ft^2 + 1 dry well (63 ft^2)

12 bdrms x 250 ft^2 = 3,000 ft^2
Increase leach field about 2,187 ft^2 or about 729 L.F.
729 L.F. x \$4.00 = \$2,916.00

FUNDING

Alternative Methods For Financing Alternatives

Financing wastewater collection facilities can be accomplished by several methods. The selected method generally is based upon monies available and equity among the users. Grants, loans and various other methods should be investigated.

General Obligation Bonds

General Obligation Bonds are a form of bonded indebtedness which allow the governmental entity to borrow funds for a public purpose to benefit the general population within the jurisdiction of the local government. The indebtedness is repaid at a prescribed rate, for both principal and interest, from the general fund of the local government.

This form of indebtedness offers the government the highest degree of flexibility, but also imposes a high degree of fiscal responsibility upon the government to manage its general fund in a prudent manner to allow retirement of the debt within the prescribed terms.

The limitations on such bonds and the procedures for their issuance are regulated by the state constitution, state statutes, and, in the case of home rule entites, by local charters.

Revenue Bonds

Revenue bonds enable the local government entity to incur indebtedness for a special public improvement and to repay the obligation from revenues derived from the improvement constructed.

As in the case of general obligation bonds, the limitations and procedures for issuance of revenue bonds may be governed by state constitution, state statutes, and/or local charters. Revenue bonds generally contain bond convenants by which the local government agrees to maintain and operate the improvement according to a prescribed plan to insure the electorate that the improvement can, in fact, be self-sustaining. Such improvements must be for a public purpose and within the normal functions of the local government. Generally, all revenues derived from the improvement must be applied directly to retirement of the bonds and cannot be diverted to other purposes or uses.

The district boundaries may take the size and shape of the individual subareas of the study area. The improvement district could be created to finance only one element, such as water distribution, or it could include sewage treatment, drainage, street improvements, parks, recreation, and other improvements within a given jurisdiction.

Special Assessments

A special assessment is a charge imposed by a local government upon the owners of property specifically benefited by "local" public improvement. The payment by the property owners of the assessment may be accomplished by any of several plans to accommodate installment type payments.

The nature of the facilities which can be financed by this method are limited to those that benefit the immediate locality and those property owners who are being assessed as opposed to one which confers a substantially equal benefit to the whole community or public-at-large. As a general rule, the assessment to any particular property owner cannot exceed the cost of the benefit the property owner receives.

Special assessment improvements are generally initiated by a petition of the property owners directly affected and, depending on the constitution, statutes, and local charter limitations, usually require an affirmative election by a majority of the property owners within the approved district.

Bank Loans

Short term bank loans are another source of capital funds. Limited use of this source prevails because of the short term pay back period and greater interest rates. However, this method could be used in conjunction with connection fees to finance a portion of the recommended facilities.

Contributions

Contributions can be a very useful method to finance small projects or to finance reports and studies which provide benefit to a limited interest.

Connection Fees

Connection fees which are levied prior to a building permit being issued. They are intended to be utilized for future improvements or for repayment of bonds with the surplus to be utilized for capital improvements.

Annexation Fees

Annexation fees are levied in order to help pay for existing facilities which are to be used by the annexed area.

Federal and State Loans and Grants

Several sources of federal and state loans and grants are available under the appropriate conditions to assist in financial wastewater system projects.

- Public law 92-500 - amendments to the Federal Water Pollution Control Act.

  This program provides 75 percent grant assistance to counties, cities, towns, and those special sewer and/or water districts established under applicable state laws. The grant program covers all phases of project development, from planning through engineering and construction. The process is commonly referred to as the "Step Process" and is divided into three phases. Step 1 grants, or 201 facilities planning grants, provide for the planning phase, including development of the plan of study, evaluation of alternate methods of treatment and waste disposal, and resolution of the environmental issues addressed in the study. Step 2 grants are preliminary design of facilities, and Step 3 grants are for final design and construction. Each step must be approved by the South Dakota Department of Natural Resources and EPA before the applicant can proceed to the next step, be reimbursed for, or awarded a grant.

Under the construction grant program, wastewater treatment facilities, interceptors, and collection systems are eligible projects. The collection system however, is eligible only if two-thirds of the houses in the area to be sewered were constructed prior to 1972.

- Farmers Home Administration (FmHA) community facility loans, water and waste disposal systems for rural communities.

The Farmers Home Administration makes loans at 5 percent interest for up to 40 years to communities under 10,000 population or sanitation districts organized under applicable state laws. Inquiry should be made through the FmHa county supervisor. A preapplication conference is arranged and application forms are provided for the potential applicant. Proof that the applicant cannot obtain financing at comparable or near comparable interest rates must be furnished. The A-95 review process as explained in EPA Grant procedures must be adhered to and comments become part of each application. An environmental assessment must also be prepared. All application processing is conducted through the county supervisor.

Wastewater treatment facilities, interceptor systems and collection systems are eligible for participation under this loan program. It should be noted that this vehicle is being used to finance collection systems where EPA is assisting with planning and construction of wastewater treatment facilities.

The Community Facilities Loan Program has assisted countless smaller communities throughout the nation with planning and construction of their wastewater systems. Congressional authorization and appropriation for this particular program have remained at relatively high levels.

Grants can be made for up to 50 percent of project costs provided grant funds are available. Traditionally, FmHA grant and loan funds have been used together to bring the user costs in line with current economics of comparable communities or districts. Grants are processed in the same manner as loans and are applied for simultaneously when grant funds are available or are expected to be available through congressional authorization and appropriation.

- Economic Development Administration (EDA) Grants and Loans for Public Words and Development Facilities.

Cities, towns, and private or public non-profit corporations located in designated EDA redevelopment areas are eligible for grant and direct loan assistance to plan, design, and construct wastewater systems.

The public works grants rate is 50 percent of the project cost. In instances where the area is determined to be a severely depressed area, up to 80 percent funding is possible. Designated Indian reservations are eligible for 100 percent assistance.

Long term, low-interest loans for up to 40 years may be made when financial assistance is not otherwise available from private lenders or federal agencies on terms that would permit accomplishment of the project.

A prime qualification for this program is the project's ability to fulfill a pressing need in the area, particularly in providing employment opportunities, encouraging business or industrial development, and benefiting long-term unemployed or members of low income families.

A community or district can find out if they are in the properly designated area for this program through county officials, regional council of government staff, or the State EDA representative.

If eligible, the community must contact the State EDA representative and request a meeting to determine merits of the project before preapplication. Preapplication conferences are held at the regional offices and, if approved, all processing is handled directly through the regional office. The project must also be reviewed under A-95 procedures and an environmental assessment made.

- Farmers Home Administration (FmHA), Section 601 - Energy impacted area development assistance program.

The objective of this program is to help areas impacted by coal or uranium development activities by providing assistance for the development of growth management and housing plans. They also can assist in developing and acquiring sites for housing, public facilities and services. An approved designated area consists of a county, a group of counties, or a part of a county which has been designated as an impacted area by the Governor of the State and approved by the Secretary of Energy.

Up to 75 percent of the actual cost of developing or acquiring sites for housing, public facilities, or services for which financial resources are otherwise not available may be obtained. The facilities include water and sewer connections and the necessary water and sewer lines to housing and public facilities sites.

Designation criteria is based on increases in eligible employment and also on housing and public facility conditions.

- Department of Housing and Urban Development (HUD) Community Development Act of 1974.

  The Community Development Act of 1974 is an extremely broad and all encompassing program which generally has eliminated all categorical grant programs traditionally administered by HUD by creation of a block grant delivery system. This system puts the prime responsibility on the community and its elected officials to determine community needs and objectives, especially as they relate to the low income segment of the community. This includes housing, public works, social concerns, etc.

  The sum of $8.3 million has been authorized for South Dakota for fiscal year 1980. The total is broken down into $2.4 million for large metropolitan areas and $5.9 million for non-metropolitan small cities. Spearfish is classified in the non-metro small city category and would compete for the money allocated to that account.

  The grant is for 100 percent with no match required from the community. HUD, however, will evaluate how the community is supporting other community development activities. Public works, including wastewater systems, are eligible projects. A-95 procedures and public hearings must be carried out, and responsibility for making an environmental assessment and applicable decisions rests with the community and its elected officials.

Current Course of Action

The Sixth District Council of Governments is currently conducting a study to evaluate the potential of annexing seven areas surrounding Spearfish. Preliminary evaluation indicates the most probable annexation site is the upper and lower valley region and the Christensen Drive area. Final results of the study were to be available in 1980.

The Spearfish Valley Sanitation District is currently involved in procedures to annex the West Subdivision area. Public hearings have been held but no decisions have yet been made available.

Financial Options

As previously discussed there are several potential methods for funding wastewater facilities. The final funding arrangements should result in equitable user charges for the entire service area.

The grantee, Spearfish, is eligible for 75 percent funding of a new wastewater treatment facility and associated interceptors. The remaining 25 percent will have to be financed by the city through bond sales, current budget surplus, FHA, HUD, EDA or any other funding options available.

Outlying areas which are not part of the city or a sanitation district must be annexed into the city or the existing Spearfish Valley Sanitation District, or form a separate entity. If the areas are annexed into the city, EPA grant funds will be available to the areas. If a separate entity is formed by an outlying area or annexation in the Sanitation District is established, an agreement will have to be established with the City of Spearfish whereby 75 percent funding of interceptors from the entity to Spearfish is possible. The remaining 25 percent of the interceptor and the collection system within the entity would have to be funded by alternative means. Grants are available, depending on conditions, to areas which have excessively high user fees. These grants are available through Farmer Home Administration and Department of Housing and Urban Development. Long-term low interest loans are also available through Farmer Home Administration.

NONPOINT SOURCES

Nonpoint sources of pollution are identified as a primary cause of surface water and alluvial groundwater* pollution in the Spearfish 201 planning area. Nonpoint pollution is defined as the accumulated pollutants in the stream, diffuse runoff, seepage, and percolation contributing to the degradation of the quality of surface and groundwaters. The sources of nonpoint pollution within the Study Area originate from two distinct types:

- Natural
- Man related

Natural nonpoint sources are the result of the natural, unaltered, environmental conditions of a drainage basin. These include naturally occurring mineralized springs and seeps, and the natural geologic, soil, vegetal, and faunal materials that are eroded from the land by precipitation. These natural sources are difficult to quantify and control. Where these sources can be isolated, such as springs, some specific management practices could be implemented in hopes of reducing the pollutant loads reaching surface water.

These natural sources are not thought to be the major water pollution sources in the Study Area.

Man related sources of nonpoint pollution are a direct consequence of human activities within the Study Area. These activities either disrupt the natural environment causing an acceleration in the rate of natural pollutants entering streams, or create a pollution source by introduction of foreign material into the natural landscape.

Man related sources of nonpoint pollution in the Study Area are related to the following activities:

- Urban Stormwater Runoff
- Agriculture (livestock confinement/concentration areas)
- Construction (urban and suburban expansion)
- Septic tank systems

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*Alluvial groundwater is water in an aquifer composed of unconsolidated material deposited by water action. This water is recharged by surface water and is hydraulically connected to the surface water system.

Additional sources of nonpoint pollution in Lawrence County but outside the boundaries of this Study Area include:

- Silviculture
- Mining

Various State and Federal agencies have adopted best management practices (BMP's) for controlling nonpoint pollution from human activities. The Sixth District Council of Governments, whose planning area includes the 201 Study Area, have identified nonpoint source BMP's that are applicable to their planning area.

The BMP's are defined as a practice or combination of practices that are determined by a state after problem assessment, examination of alternative practices, and appropriate public participation to be practicable and most effective in preventing or reducing the amount of pollution generated by diffuse sources to a level compatible with water quality goals (13). Where practicable, BMP's should consist of nonstructural controls, such as good land management. Structural controls should be implemented when nonstructural controls are ineffective.

The goal of nonpoint source pollution control is to reduce/eliminate pollutant material from being delivered to surface water. This process, in many cases, involves the control of erosion and sediment. Sediment from erosion is identified as the major pollutant in terms of volume within the Sixth District planning area (13). However, within the 201 Study Area, biological contamination from agriculture and urban stormwater runoff is identified as the pollutant creating the major water quality problems.

Nonpoint sources manifest themselves throughout the region and therefore BMP's for control of the known nonpoint sources will be summarized. The ability of any agency to implement nonpoint source controls will be dependent upon the availability of funds and manpower. Detailed BMP's and maximum soil loss guidelines will be developed by the Conservation Districts on a district by district basis to reflect local conditions. Lawrence County must work with the local district in developing these practices. Additionally, coordination and implementation of BMP's to correct the nonpoint sources identified within the 201 Study Area should occur between the City of Spearfish, Lawrence County, and the local Conservation District.

Controlling Nonpoint Sources of Pollution

The following sections summarize the various management practices that are recognized as being effective in controlling nonpoint sources of pollution in the area. Many of the management practices that have been inventoried are utilized in construction, forest management, mining, and urban management planning as well as in agriculture. Management practices which are followed by an asterick (*) are applicable to correcting the identified nonpoint sources in the 201 Study Area. Those practices which are followed by a dash (-) are identified as useable in the Sixth District 208 planning area (13). Costs are presented when found available for a specific management practice.

Urban Stormwater Runoff

Studies on the urban stormwater runoff problem have increased in the last several years since the passage of the Clean Water Act in 1972. These studies have resulted in considerable information regarding the quality of urban stormwater. The contaminant load, or the chemical composition of urban stormwater is extremely variable. This is a consequence of the myriad of activities in and around an urban area. Typical parameters monitored to assess urban stormwater quality are: biochemical oxygen demand, chemical oxygen demand, volatile suspended solids (indicator of organic pollution), suspended solids (indicator of organic pollution), suspended solids (indicator of particulate matter), and coliform bacteria (indicators of biological contamination).

Based on information evaluated during the Sixth District 208 Study, the City of Spearfish is rated as having the second highest priority for nonpoint source pollution. The first priority is Rapid City. The water pollution potential from urban stormwater from Spearfish is rated as moderate (14).

Three primary approaches to abatement of stormwater runoff are:

- Source control to remove the contaminants before they are picked up by the runoff water.
- Treatment of storm and combined sewer flows to remove pollutants before discharge.
- A combination of the above two management practices.

The following practices are recommended for dealing with urban runoff in the Sixth District planning area.

- Institute a street sweeping program, preferably using a vacuum sweeper to insure removal of fines (*,-).
- Alter peak runoff flow by designing new parking lots to temporarily slow or store runoff (*,-).
- Employ parks and other open space as temporary storage (*,-).
- Install small retention ponds or modify the storm sewer system to provide off-line storage. Stored sewage and surface runoff should then be fed back into sewerage lines for treatment at the wastewater treatment plant (*,-). (Note: Treatment of surface runoff at a wastewater plant is not a grant eligible item under EPA funding criteria).
- Encourage private property owner cooperation with goal of storing stormwater on-site for controlled release (*,-).
- Increase distance of flow to stream by constructing diversion structures (*).

- Install holding tanks with controlled release devices (*).
- New pavement construction consisting of porous asphalt pavement for roadways and parking lots.
- Periodic perforation of public and private lawns to increase infiltration.
- Temporarily store stormwater on flat or slightly sloping roofs equipped with detention drains.

Implementation of any of these management practices will require evaluation for cost and treatment efficiency on a small scale.

Agricultural

Agricultural practices in the 201 Study Area are separated into the following three categories:

- Livestock confinement/concentration area
- Dry land/range land
- Irrigated land

Strategies presented for controlling nonpoint pollution from these categories are taken directly from the Soil Conservation Service (SCS) Standards and Specifications for the respective management practice. Many of these management practices are applicable to other activities and should not be viewed as only agriculturally oriented. Following each agricultural categories is a list of the management strategies pertinent to nonpoint source controls for the activity.

The definition, scope, purpose, and/or applicability of each practice is provided in Appendix B. Specific design must be developed on a case by case basis. General design criteria may be found in the various SCS Technical Studies. Management practices should be developed for each farm or ranch individually. This should occur in cooperation with appropriate agencies.

Livestock confinement/concentration area

Water quality is seldom seriously impacted by those animals that are grazing on well managed range land or on well maintained hay pastures. The primary situations where livestock may adversely impact water quality are related to concentrated feeding areas, the overuse of pasture land, and concentrated access on surface streams.

Livestock confinement areas along Higgins Gulch are one of the primary sources of water pollution in the Study Area. The bacteria and organic compounds entering surface and alluvial groundwater from these areas are contributing to the contamination of the Belle Fourche water supply.

Feedlots are classified as point source dischargers if they contain over 1,000 head of livestock. Smaller feedlots that drain directly to a stream are also required to have discharge permits.

The primary best management practice for feedlots is the selection of a proper location and the use of a nonpolluting method of waste disposal.

When trying to decide if an area is a feedlot or just a pasture, a benchmark that can be used is that if the animals have used the area heavily enough to kill the grass, it is a feedlot. Winter feeding sites, where the hay is spread on a field for the livestock, are normally not considered to be feedlots.

Management Strategies*	Reference Page in Appendix B
Agriculture Waste Management System (312-1)	B-1
Deferred Grazing (352)	B-6
Disposal Lagoon (359-1)	B-7
Diversion (362-1)	B-8
Drainage Field Ditch (590-1)	B-8
Fencing (382)	B-11
Floodwater Diversion (400-1)	B-11
Holding Pond (425-1)	B-15
Livestock Exclusion (472)	B-29
Pipeline (516-1)	B-31
Structure for Water Control (587-1)	B-39
Trough or Tank (614-1)	B-43
Well (642-1)	B-43

Dryland/Rangeland

Erosion and the resultant soil loss is the principal nonpoint source of water pollution from dryland farming and grazing. Man-induced accelerated erosion costs agriculture millions of dollars annually. The South Dakota Division of Conservation estimates that nutrient loss alone exceeds 200 million dollars per year in South Dakota (13).

The Sixth District Council contracted with the Soil Conservation Service to analyze erosion and sediment yields from nine watersheds and to recommend management priorities best suited for sediment control in their planning area. A detailed discussion of their findings is presented in reference 13.

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*Numbers after titles refer to SCS Technical Guide publications.

The BMP's for sediment control identified by SCS should be developed on a field-by-field basis as conditions vary from site-to-site. Generalized examples of BMP's include:

- Leave native vegetation in the bottom of all drainages.
- Minimize tillage.
- Consult the Soil Conservation Service before breaking rangeland and converting the crop production.
- Leave a buffer strip along streams and reservoirs.
- Construct check dams where economically feasible.
- Fence range land to get more uniform use.

Additional management practices include:

	Reference Page in Appendix B
Access Road (560-1)	B-1
Critical Planting Area (342)	B-4
Deferred Grazing (352)	B-6
Firebreak (382)	B-11
Grazing Land Mechanical Treatment	B-15
Holding Pond (425-1)	B-15
Livestock Exclusion (472)	B-29
Pasture and Hayland Management (510)	B-30
Pasture and Hayland Planting (512)	B-31
Planned Grazing System (556)	B-31
Proper Grazing Use (528)	B-34
Spring Development (574-1)	B-37
Stock Trails and Waterways (575)	B-37

Conservation land treatment and range management measures will control erosion and reduce sediment yields. SCS has identified some land treatment measures that may be used in the Sixth District planning area and associated costs. This information is presented in Table 5-6. Proper range management involves several practices.

TABLE 5-6

LAND TREATMENT MEASURES AND COSTS, 1977 DATA

Conservation Land Treatment Measures	Installation Costs Flat Rate
Conservation Cropping System*	-
Contour Farming	$1/acre
Cover and Green Manure Crop	$12/acre
Critical Area Planting	
Shaping	$140/acre
Cover Crop	$12/acre
Seed and Seeding	$30/acre
Mulching	$160/acre
Sodding	$800/1,000 sq yd
Crop Residue Use	-
Structures (40¢ per cu yd)	$400/1,000 ft
Grassed Waterway	$500/acre
Grasses and Legumes in Rotation*	-
Minimum Tillage**	-
Pasture and Hayland Management	-
Contour Stripcropping	$5/acre
Stubblemulching**	-
Level Terrace	$140/1,000 ft

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* Growing crops in combination with cultural and management measures that reduce erosion, conserve moisture and maintain soil tilth and fertility. Costs vary with individual crops.

** No additional cost over conventional tillage. Tillage costs included as crop production costs.

Source: Soil Conservation Service In Reference 13.

Irrigation

Irrigation is a major beneficial use of water within the Sixth District planning area. Concentrated irrigation development is centered around three areas: The Belle Fourche project, the Angostura project, and the Rapid Valley. There are also thousands of acres of smaller irrigated areas.

The goal of the best management practices should be to control salinity, the leaching of nutrients, and sediment production, not eliminate them (13).

Management Practices	Reference Page in Appendix B
Chiseling and Subsoiling (324)	B-3
Conservation Cropping System (328)	B-4
Contour Farming (330-A)	B-4
Crop Residue Use (344-A)	B-4
Drainage Field Ditch (590-1)	B-8
Drainage Land Grading (462-1)	B-9
Drainage Main or Lateral (480-1)	B-10
Grassed Waterway or Outlet (412-A)	B-14
Grasses and Legumes in Rotation (411)	B-15
Irrigation Canal or Lateral (320-1)	B-16
Irrigation Ditch and Canal Lining (Concrete and Pneumatically Applied Mortar) (358-A-1)	B-17
Irrigation Ditch and Canal Lining (Flexible Membrane) (358-B-1)	B-17
Irrigation Ditch and Canal Lining (Galvanized Steel (358-C-1)	B-18
Irrigation Field Ditch (388-1)	B-19
Irrigation Land Leveling (464-1)	B-19
Irrigation Pipeline (432-A-1, 432-B-1, 432-C-1, 432-D-1, 432-E-1)	B-20
Irrigation Pit (552-B-1)	B-23
Regulating Reservoir (552-B-1)	B-24
Irrigation Storage Reservoir (436-1)	B-25

Management Practices	Reference Page in Appendix B
Irrigation System, Drip (441-1)	B-25
Irrigation System, Sprinkler (443-1)	B-26
Irrigation System, Tailwater Recovery (447-1)	B-27
Irrigation Water Management (449-1)	B-27
Minimum Tillage (478)	B-29
Mulching (484)	B-29
Straw Mulching (484-Supplement 1)	B-29
Regulating Water in Drainage Systems	B-36
Stripcropping (585-A, B, C)	B-38
Stubble Mulching (344-B)	B-40
Subsurface Drain (606-1)	B-41
Toxic Salt Reduction (610)	B-42

It must be pointed out that while an attempt has been made to segregate BMP's by agricultural practices several of them are applicable to other than the category listed. Furthermore, SCS has identified several other management practices which can be applied to a broad range of activities besides agriculture. These management strategies are listed below:

Management Practice	Reference Page in Appendix B
Clearning and Snagging (325-1)	B-3
Dam, Multi-purpose (349)	B-5
Debris Basin (350-1)	B-5
Dike (356-1)	B-6
Emergency Tillage (365)	B-10
Farmstead and Feedlot Windbreaks (380)	B-10
Floodwater Retarding Structure (402-1)	B-12
Floodway (404-1)	B-13
Grade Stabilization Structure (410)	B-14
Grassed Waterway or Outlet (Natural Watercourse (412-A)	B-14
Land Smoothing (466-1)	B-28

Management Practices	Reference Page in Appendix B
Open Channel (582-1)	B-30
Pond Sealing or Lining (521-A-1, 521-B-1, 521-C-1, 521-D-1)	B-33
Pumping Plant for Water Control (533-1)	B-34
Range Seeding (550)	B-34
Recreation Area Improvement (562)	B-35
Recreation Area Stabilization (561-1)	B-35
Recreation Land Grading and Shaping (566-1)	B-35
Recreation Trail and Walkway (568-1)	B-36
Stream Channel Stabilization (584)	B-37
Streambank Protection (580-1)	B-38
Terrace, Basin (599-1)	B-42
Tree Planting (612)	B-42
Woodland Direct Seeding (652)	B-44
Woodland Improvement (666)	B-44
Woodland Pruning (660)	B-44
Woodland Site Preparation (490)	B-45

Construction Management Practices

Construction activities are capable of producing large quantities of suspended solids and many other types of contaminants in receiving waters. The quality and type of pollutants produced by construction work depends on many factors. A partial list of these factors includes:

- the type and duration of the many construction practices
- the size and location of the construction site relative to a water course
- the rainfall intensity and frequency
- pest control measures
- soil type

- relation of wind to the erosion potential of the soil
- the number of construction workers needed for the work
- the type and quantity of machines necessary for accomplishing the task.

Local erosion control practices will play a significant role in the quantity of pollutants discharged to the receiving water. It must be emphasized that identification of the necessary management practices for nonpoint source control should occur during the initial planning and design of a project. Some of the problems which should be taken into account include:

- Groundwater contamination
- Potential mudslide or landslide areas
- Stream crossing structures
- Landfills, culverts, dikes, and building encroachments on surface waters
- Increased stormwater runoff
- Diversion and gradings that may change existing drainage patterns
- Borrow pit construction
- Removal of accumulated sediment
- Stream channel modifications
- Chemical water disposal
- Dust and smoke control
- Temporary road construction
- Construction site location relative to water bodies
- Construction of temporary water settling basins

The following is an inventory of nonpoint control management practices for construction activities. This information has been edited from the EPA report on "Process, Procedures, and Methods to Control Pollution Resulting from All Construction Activity." Further explanation of the management practices listed below is presented in Appendix B.

Construction Management Practices

Surface Roughening - This practice reduces the ability of moving water to detach soil particles and transport them.

Interception and Diversion Practices - These are practices designed to intercept runoff before it has a chance to come in contact with an erodible soil surface and to divert it to a safe disposal area.

Vegetative Stabilization - Vegetation is used both for temporary or short-term stabilization and permanent or long-term stabilization.

Non-vegetative Soil Stabilization - As in the case of vegetative soil stabilization, non-vegetative soil stabilization includes both temporary and permanent stabilization.

Vegetative Practices - The principal types of vegetative practices include vegetative buffers and the soil inlet filter. Buffers are used to detain, absorb, and filter overland runoff and thus remove sediment from the water. They include natural vegetative buffers, installed vegetative buffers, and contour strips or buffers.

Structural Control Practices - Sediment control structures include filters, traps, basins and diversion structures. These practices vary widely in cost, complexity, and effectiveness. Commonly used filters include the gravel inlet filter and the filter berm. Both are constructed out of coarse crushed stone or gravel and are usually only effective in removing the coarser textured sediment.

Specialized Sediment Techniques - These refer to channel relocation and water treatment.

Control of Pesticides, Nutrients, Solid Waste, Construction Chemicals, Petroleum Products, Other Pollutants - The Sixth District Council has identified several BMP's and their associated costs for their planning area (13). These data are presented in Tables 5-7 and 5-8.

Septic Tank Systems

Septic tank systems of the 201 Study Area are evaluated in detail in Appendix A. Practices that are identified for controlling these facilities include:

- Identify soil capabilities to assimilate wastewater and density of units.
- Proper design, installation, and maintenance.
- Adhere to South Dakota septic tank regulations.

Pollution problems associated with septic tanks in the Study Area are limited.

Silviculture (Forestry)

After agriculture, more land in the Sixth District planning area is devoted to forest resources than to any other land use (13). This can be seen by comparing the number of acres classified as Forest and Woodland managed by the U. S. Forest Service (1,050,000 acres) plus that managed privately (215,000 acres) to that within the project area. Approximately

TABLE 5-7

ALTERNATIVE BEST MANAGEMENT PRACTICES FOR CONTROLLING CONSTRUCTION EROSION

Strategy	Management Practice	Reduction in Sediment Yield	Cost per Acre (1976)
I	Seed and fertilizer	36%	$ 550
II	Chemical protection* for 12 months	44%	$1,300
III	Seed, fertilizer and chemical protection for three months*	48%	$1,350
IV	Seed, fertilizer and chemical protection for 12 months*	62%	$1,350
V	Seed, fertilizer and straw mulch	65%	$1,250
VI	Seed, fertilizer and chemical protection for 12 months and a sediment retention basin serving 100 percent of the site*	90%	$1,550
VII	Seed, fertilizer, straw mulch and a sediment retention basin serving 100 percent of the site	93%	$1,450

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* Examples of chemical protection are the asphaltic and rubber emulsions.

Source: Dalton-Dalton-Little-Newport

TABLE 5-8

COST DATA FOR IMPLEMENTATION OF SOIL EROSION AND SEDIMENTATION CONTROL ALTERNATES (1976 DOLLARS)

Treatment		Cost
Check dam, gravel and earth:	1' high x 5' wide	$1.81/cubic foot
	2' high x 15' wide	0.82/cubic foot
Check dam, grouted rock riprap:	2' high x 5' wide	6.91/cubic foot
	3' high x 10' wide	6.62/cubic foot
	5' high x 20' wide	8.05/cubic foot
Check dam, concrete:	2' high x 5' wide x 4' long	590/cubic yard
	5'6" high x 9'8" wide x 5' long	144/cubic yard
	7' high x 20' wide x 20' long	214/cubic yard
Diversion dikes		4.45/linear foot
Erosion checks		3.39/linear foot
Filter berms		5.43/linear foot
Filter inlets		10.49/cubic yard
Flexible erosion control mats		1.10/square foot
Gabions:	10 square yard surface area	29.71/square yard
	100 square yard surface area	15.29/square yard
	1000 square yard surface area	12.50/square yard
Interceptor dikes		4.45/linear foot
Sandbag sediment barriers		3.06/bag
Sediment retention basins:	6' high x 30' long	13.60/cubic yard
	7' high x 30' long	12.71/cubic yard
	8' high x 30' long	10.37/cubic yard
Straw bale sediment barriers		7.76/bale
Straw and/or hay		1,184/acre
Jute netting		7,600/acre
Woodchips, 3" cover, unseeded		7,896/acre
Woodchips, 3/4" cover		3,060/acre
Wood fiber mulch by hydroseeder		424/acre
Sod blankets		14,603/acre
Chemical soil stablizers		1,283/acre

Adapted from USEPA.

11 percent of the land area within the Black Hills 208 Project is devoted to Forests and Woodlands and an additional 4 percent is administered by the U. S. Forest Service as national grassland. Best management practices for silviculture are developed by the U. S. Forest Service in cooperation with the South Dakota State Forester. Within the 201 Study Area timber production is not occurring, however application of such BMP's with the National Forest would serve to protect water in Spearfish Creek and Higgins Gulch.

Mining

Historically, mining has had a severe impact on water quality; western South Dakota has been no exception. Mineral extraction requires the blasting, removal and milling of large volumes of material. The void created receives and can concentrate runoff which may intercept groundwater, or infiltrate into an aquifer. Milling wastes dumped in a floodplain, mine void, or on a hillside are subject to the weathering action of rainfall and surface water. The sum of all these conditions, the mingling of water with newly weathering minerals, presents a great potential for water pollution.

Management practices suggested in the Sixth District 208 report should be applied in Lawrence County where applicable. No mining activities are identified in the 201 Study Area.

NONPOINT SOURCE MANAGEMENT AGENCIES (13)

The following discussion summarizes the basic framework and parameters for the implementation of the nonpoint source control plan recommended in the Sixth District 208 Study.

The management system must be able to regulate the following nonpoint source activities: agriculture, silviculture, mining, construction, residual waste disposal, land and underground pollutant disposal, and hydrographic modifications.

Management agencies must also have public representation and must be existing institutions with existing legislation. The Conservation Districts will assume lead roles for the implementation of nonpoint source control measures.

The agencies recommended already have the required statutory authority under existing laws. Several of the recommended agencies have a continuing effort regarding water quality which should be stressed and continued. The primary recommendations are listed below. Sixth District Council of Local Governments:

1. Provide technical assistance to member units of government regarding water quality.
2. Coordinate and compile the annual revision of the 208 plan with an advisory committee composed of the implementing agencies and citizen members.

3. Insure that the annual revision will be a locally developed plan with public participation.

Municipalities:

1. Assist in the development of and assume the responsibility for implementing the Erosion and Sediment Control Program in incorporating areas.

2. Establish a program for reducing pollutants in urban runoff within the limits of existing legislation.

3. Adopt any ordinances, as pretreatment of industrial wastes, required for compliance with related federal laws.

Counties:

1. Assist in the development of and assume the responsibility for implementing the Erosion and Sediment Control Program regarding non-agricultural activities.

2. Develop appropriate plans to provide for orderly growth and minimize the impacts of development.

3. Enforcement of existing household wastewater disposal regulations.

Division of Conservation:

1. Assist the Conservation Districts.

2. Insure the proper reclamation of surface mining operations.

3. Prevent contamination of groundwater by exploratory drilling and geophysical surveys.

Department of Game, Fish and Parks:

1. Review the actions of state and federal agencies relative to their compatibility with the preservation of fisheries.

2. Continue the policy for the control of off-the-road vehicle use with educational effort.

3. Develop an educational program for private forest owners on erosion control.

Department of School and Public Lands:

1. Implement the practices recommended by the Conservation Districts on school lands.

South Dakota Department of Natural Resource

1. Prevent contamination of groundwater by oil and gas exploration or production.

2. Review proposed irrigation projects to determine their impact on the quality of surface and groundwater.

3. Review and recommend to the Governor decisions on 208 Water Quality Plans.

Soil Conservation Service:

1. Provide assistance to the Conservation Districts in the implementation of the erosion and sediment control program and the establishment of an education program.

2. Give priority to cost-sharing programs regarding water quality.

Agricultural Stabilization and Conservation Service:

1. Encourage the set-aside of areas sensitive to erosion.

2. Give high priority to cost-sharing practices that benefit the people downstream as opposed to those practices primarily for the benefit of the property owner.

3. Verify that cost-shared projects are properly maintained.

Cooperative Extension Service:

1. Provide more aggressive educational programs relating to all aspects of water quality.

U. S. Forest Service:

1. Provide for the implementation of proper management practices on U. S. Forest Service System lands.

2. Reclaim unnecessary roads and trails.

3. Develop and publicize wet season travel restrictions through an educational program.

Bureau of Land Management:

1. Provide for the implementation of proper management practices on Bureau of Land Management lands.

2. Incorporate the proper protective requirements into any permits, leases, management plans, etc.

FLOODPLAIN/HAZARD IDENTIFICATION

Introduction

Encroachment on floodplains, such as residential/commercial development reduces the flood-carrying capacity and increased flood heights, thus increasing flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. As human occupation of the land increases the flood damage potential increases correspondingly. Two principal methods are commonly employed to prevent or abate flood damages as follows:

- The construction of dams and protective works to either impound flood waters or to limit their flow within predetermined boundaries.

- The adoption of legal restrictions concerning the occupation of flood hazard areas.

Of the two methods used to control floods, restricting occupation in flood hazard areas is likely the more economical and effective solution for the Spearfish area. Most flood damages occur in areas where the flood hazard was or should have been readily apparent.

Identification of Floodplains

Definition

A floodplain can be described as an area adjacent to a stream, which is subject to flooding as a result of the occurrence of an intermediate regional flood and which is so adverse to past, current, or foreseeable construction or land use as to constitute a significant hazard to public health and safety or to property.

In an attempt to define the frequency of an intermediate regional flood statistically, the terms 100-year flood or 1 percent flood are commonly used. This does not specify the actual recurrence interval between such floods but rather that on a statistical basis it can be expected to occur once in a 100 year period. The best that can be said is that these terms describe a type of flood for which reliable evidence is available and which can be expected to reoccur at any time, but on a rather infrequent basis. Whatever its frequency, the certainty of its happening from time to time within the predicted time parameters is sufficient to justify the adoption of prudent methods to prevent the loss of human life and the destruction of property. An intermediate regional flood falls far below the maximum possible flood, but considerably above those lesser floods which usually occur during each spring thaw.

For purposes of the National Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 100-year flood is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment in order that the 100-year flood be carried without substantial increases in flood heights. As minimum standards, the Federal Insurance Administration limits such increases in flood heights to 1.0 foot, provided that hazardous velocities are not produced.

Delineation

There will never be any total agreement concerning the calculations which should be made to compute the amount of water at any given point which constitutes an intermediate regional flood. However, there is sufficient standardization in procedure to permit the reasonable identification of such a flood. For the purposes of Lawrence County, the calculations should be based on the 100 year flood flow in Spearfish Creek of 7,460 cfs as defined by the U. S. Army Corps of Engineers. The overriding consideration is that the mapping must be in such sufficient detail as to permit identification of the flood hazard area on the ground itself. The average cost of such mapping is currently about $3,000.00 per lineal mile. The total cost of detailed floodplain identification is about $6,000.00 per lineal mile. These costs may be greater or lesser depending upon the detail desired and the width of the area to be covered.

If Lawrence County can not fund, either directly or through grant assistance, the necessary floodplain boundary mapping it could be accomplished by the individual developer's engineer. Such a procedure would require obtaining cross-sectional information, use the approved flow, and calculation of the flood depth using open-channel hydraulic formulas.

From any computed volume of water in a stream, its velocity and territorial occupation can be predicted with considerable accuracy. The obvious purpose of defining any probable flood is to make it possible to trace its path upon the ground. The end product of any floodplain study must be a map of such adequate detail as to permit the ready identification of the flood hazard area on the ground.

The scale of mapping may vary from area to area. In general, much greater detail and smaller contour intervals are needed in urban and developing areas than in rural or undeveloped areas. Each local governmental agency must determine for itself the scale and other detail which goes into the mapping program.

The delineation of the flood hazard area by adequate mapping and accompanying data report constitute the finished product upon which land use decisions should be based.

It cannot be over emphasized that floodplain delineations are valid only as long as those conditions exist which existed at the time the delineation was made. Natural changes in the carrying characteristics of any stream can be predicted to some extent, but changes made by man cannot be predicted. Severe changes in the configuration of any floodplain can be made by the placement of restrictive bridges or culverts, by floodproofing measures, or by any other methods which alter either the normal or flood channel of the stream.

FLOODPLAIN PRIORITIES

Lawrence County does not currently have the funds and trained personnel to accomplish flood hazard identification for all streams. Therefore, it is necessary to establish stream priorities to accomplish flood boundary mapping. The following is a suggested criteria for establishing the need for mapping priorities.

Priority 1 - Areas proposed for immediate development.

The best and most obvious method of minimizing the flood hazard threat is to restrict the occupation of flood hazard areas before such occupation actually occurs. Immediate development is herein arbitrarily defined as a period of within five years. The area contemplated for development is one with little or no existing development. The area is normally characterized by soaring land values and is under pressure because of high density development in adjacent areas. Intense political and economic counterpressure can be expected to be brought against efforts to initiate land use controls.

In summary, the first priority describes a flood hazard area in which human occupation can be expected to take place within a future period of five years, unless some type of land use controls are accomplished.

Priority 2 - Areas already occupied.

This second priority defines those flood hazard areas which are already occupied. While occupation is already an accomplished fact, some relief can be obtained through floodproofing measures, by making flood insurance available and by regulating future building.

Priority 3 - Areas of more future potential development

This third priority describes those flood hazard areas in which potential development can be expected to occur at a time more distant in the future than five years, unless land use controls are initiated.

LAND USE CONTROLS FOR FLOODPLAIN DEVELOPMENT

As indicated above the County does have the option, concurrently to floodplain mapping, to implement land use controls. These controls typically are in the form of building and zoning ordinances. The current Floodplain District Ordinance is lacking since an accurate floodplain boundary to establish a District is not available. A model ordinance for floodplain management that would provide guidance and enforceability once floodplain Districts are established is presented in Appendix C.

Model Floodplain Ordinance

It is recognized that finalization and approval of a comprehensive floodplain ordinance for Lawrence County will require time. It is also recognized that local political and development pressures opposed to land use controls can lengthen the process. The County does have the interim option to continue and expand existing moratoriums on development in alluvial areas. Such a position is likely to bring additional pressure from pro-development interests. However, it must be emphasized that these actions are oriented toward the protection of public health, safety, and welfare. See Chapter 1 for the proposed EPA grant condition restricting floodplain development.

FLOODPLAIN MAPPING ASSISTANCE

The principal federal agency engaged in floodplain delineation is the United States Corps of Engineers. In more recent years, the United States Soil Conservation Service and the United States Geological Survey have also engaged in floodplain studies and are expanding their activities in this field. As a result of the establishment of a national flood insurance program in 1968, the Federal Insurance Administration is also engaged in flood hazard studies, although generally on a contractual basis.

While the above described federal agencies can be of great assistance in delineating floodplains, there will always be a limit to the funding available. In most cases, the available federal funds can be supplemented with state and local funds. It is the responsibility of the South Dakota Division of Conservation to coordinate and establish priorities for all floodplain studies involving either state or federal funds, or both.

The faster method of obtaining a floodplain study is for a local jurisdiction to contract with a consulting firm using its own funds. Under this procedure the study usually can be completed within less than a year and does not require any prior approval or priority scheduling. A disadvantage of this course is that it is the most expensive to the local governments.

A considerable disadvantage of federal and state funding is the required lead time for appropriations, generally at least a year. The advantage is that it is considerably less expensive to the local government involved. In such case, the local government would usually be providing only twenty-five percent or less of the total cost.

PUBLIC PARTICIPATION AND COORDINATION

CHAPTER 6

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PUBLIC PARTICIPATION AND COORDINATION

During the preparation of this document, meetings were held to inform the public and solicit public comment. These meetings have involved the public at large, vested interest groups, and local and regional governmental entities. At the outset of the project a citizens advisory committee was established and Roger Marshall, Northern Hills Sanitarian, was designated as the committee leader. The committee met officially in two public meetings and other informal meetings. The first public meeting was held March 8, 1979 and discussed the scope of the project, identified problems, public health risks, and wastewater treatment. The second public meeting on November, 1979 discussed nonpoint source problems which are contributing to the water quality problems, alternatives, and additional data requirements.

LIST OF PREPARERS

CHAPTER 7

CHAPTER 7

LIST OF PREPARERS

Environmental Protection Agency

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REFERENCES

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REFERENCES

1. Rahn, Perry H. and Arden D. Davis, Ground Water in Spearfish Valley. U.S. Environmental Protection Agency. Denver, Colorado July 31, 1979.

2. Brady Consultants, Inc. Wastewater Facilities Plan for Spearfish, South Dakota. July, 1978

3. Personnel Communication. Steve Peters Lawrence County Planning and Zoning Administrator.

4. U. S. Department of Commerce, Bureau of Census. County and City Data Book. Washington. D. C. G.P.O. 1972.

5. South Dakota State Planning Bureau. Compositing Natural Resources and Land Use Information in Spearfish, South Dakota. A Land Capability Study. 1979.

6. U.S. Soil Conservation Service. Unpublished Soil Survey of Lawrence County.

7. Department of Environmental Protection. Administrative Rules of South Dakota. Title 34, Article 34:04 Water Pollution Control Program. Revised September 21, 1978.

8. U.S. Water Resources Council. Floodplain Management Guidelines E.O. 11988. 43FR6030. February 10, 1978.

9. Federal Insurance Administration. Flood Insurance Study City of Spearfish South Dakota Lawrence County. Preliminary March 29, 1979.

10. South Dakota Planning Bureau. Land Capability Maps, Computer Generated. 1979.

11. Federal Insurance Administration. Flood Hazard Boundary Map. Lawrence County, South Dakota. June 17, 1977.

12. Lawrence County. Zoning Ordinance Concerning Floodplain Districts. Section 3.6.

13. Sixth District Council of Government. 208 Areawide Water Quality Management Planning Program. Rapid City, South Dakota. March 1978.

14. Harms, Leland, Urban Stormwater Management. Prepared for Sixth District Council of Governments. No Date.

15. Brown, K. W., Wolf, H. W., Donnelly, K. C., and Slowly, J. F. The Movement of Fecal Coliforms and Coliphages Below Septic Lines. Journal of Environmental Quality. Volume 8, Number 1, 1979.

16. Denver Urban Drainage District. Model Floodplain Ordinance is presented as a general guide for floodplain planning. Specific communities needs will dictate inclusion of specific sections.

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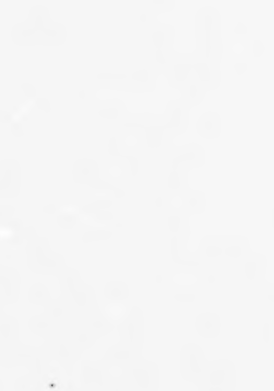

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